Antimicrobial Resistance (AMR) and Health Inequalities
An Evidence Summary

August 2025

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Acknowledgments:

Carolyn Smith, Bodleian Health Care Libraries, University of Oxford, UK for search methods, search strategies and choice of databases.

Professor David Eyre, Professor of Infectious Diseases, Big Data Institute, University of Oxford, Honorary Consultant in Infectious Diseases & Medical Microbiology, Oxford University Hospitals, for his valuable input and review

This literature summary was undertaken as part of a Small Business Research Initiative (SBRI) grant.

Contents

1 Summary

Antimicrobial Resistance (AMR) presents a significant threat to modern medicine. Many of the interventions we have come to take for granted are not possible without the safety net of antibiotics to support recovery. Currently AMR is more prevalent in low and in middle income countries, however the number of cases identified in the UK are increasing year on year. Whereas in the past the focus has been on hospital acquired AMR such as MRSA, there are now increasing numbers of cases arising in community settings.

Historically, AMR has been considered a threat that we all face. Similarly, the main healthcare focussed mitigation, antimicrobial stewardship (using antibiotics more carefully and reassessing which ones to use in what circumstances), is broadly encouraged across all patient groups.

More recently, researchers have been looking in more detail at variation, but as has been the case with other reports on health inequalities, the evidence is limited and largely focusses on the things that are easy to measure. Therefore, this report mainly outlines the prevalence of infectious disease and AMR in different populations easily identified in NHS data. There is more information about age, sex and ethnicity and less relating to other health inequality groups. It is possible these demographics may be correlated with specific determinants such as time spent overseas or vaccination hesitance. These variables might be more relevant in understanding AMR in different groups, but data are not as easily available.

Due to the prolonged focus on reducing antibiotic prescribing, there is also good data about AMR in deprived and rural areas which can be discerned by postcode. The significant gap relates to patient level data, including evidence about whether patients have access to the appropriate antibiotics at the right time, and how well they recover. While targets for reduced antibiotic use are applied at a system level, it is individuals whose health outcomes will be impacted if this reduction is not done appropriately.

The most striking findings in this review is the differential prevalence of AMR in different communities in the UK today. National antibiotic prescribing guidance appears to be largely 'one size fits all'. There are few mentions of the needs of specific groups, or reference to the need for local variation. Which communities might be at greater risk, or would benefit from a different treatment approach, are not specified. Individual hospitals and Trusts produce guidance based on local microbiology results, but these also make limited mention of different groups living in the area.

Migrant communities, and ethnic minorities living in the UK have significantly higher rates of AMR. Other communities such as prisoners may also be at higher risk, but evidence was not identified in the literature reviewed. There is evidence that for people carrying resistant strains, treatment with the 'wrong' antibiotics will not only fail to bring about the expected improvements but could potentially make things worse by allowing resistant bacteria to flourish. Vaccination can provide protection from some bacterial diseases, but vaccination rates can be lower in these population groups, further increasing their risk. Homelessness and drug use can also contribute to a higher likelihood of infection, including with AMR bacteria.

For higher risk communities, some authors such as Chukwudile et al [1] recommend pre-screening for resistant bacteria before adopting the standard treatment pathway which might not be appropriate. This could go beyond the screening already in place in the UK such as for MRSA. However, in care homes (another location where higher use of antibiotics is common) there is

some suggestion that pre-emptive testing can lead to unnecessary treatment. The complex nature of AMR, as it relates to a matrix of bacteria and antibiotics not a single condition, makes it particularly challenging to research. In conclusion, although there are indications that the increase in AMR is likely to disproportionately affect specific communities in the UK, there is limited evidence relating to their access and experiences or the outcomes of any treatment.

The table below sets out the key evidence identified and is colour coded based on the strength of the evidence, and relevance to the UK context. Grey background means no evidence identified, red is low confidence or conflicting, amber moderate confidence and green is high confidence. As evidence about access and experience was limited they are combined.

Table 1: Key evidence for each group included in the review.

	Prevalence/outcomes	**Access and Experience**
Age	U-shaped curve with youngest and oldest most likely to experience infections and mortality from infections, including AMR infections.	Limited evidence on access and experience – mostly focussed on use of antibiotics (potentially highest in older patients). Children exposed to antibiotics may be more susceptible to other infections.
Religion/belief	Limited evidence identified.	Potentially some religions at higher risk of lower vaccine uptake, leading to greater reliance on antibiotics.
Sex/gender/gender reassignment/sexual orientation/ pregnancy/maternity	Potentially AMR higher among males but limited data and may vary by age within gender.	Some evidence women more likely to use antimicrobials than men (attributed to Urinary Tract Infections, UTIs). Potential for under-treatment of men.
Asylum seeker, refugee and migrant populations	Evidence that AMR strains are more prevalent among migrant populations (reasons vary).	Known issues for this group accessing healthcare considered to be a factor in increased AMR.
Deprivation/employment /poverty	Highest rates of AMR occur in most deprived English communities.	Higher antibiotic prescribing rates identified in deprived

		communities attributed to myriad factors.
Disability/living in care homes	No specific evidence related to disability but some mention of elevated risk of AMR in social care settings.	High levels of antibiotic use in care homes including preventative prescribing and treatment of asymptomatic bacteria, potentially leading to increased resistance.
English not first language /poor health literacy	No evidence identified.	Potentially at higher risk of over-prescribing due to language barrier / difficulty explaining why antibiotics not relevant.
Mental illness, and substance use	Drug users at higher risk of infection generally but no specific data on AMR.	No evidence identified.
Geography - rural/urban/coastal	Evidence demonstrates regional variation in infection rates and AMR infection rates but limited evidence by urban/rural.	GPs in rural areas may have higher levels of antibiotic prescribing.
Marriage/civil partnership	No evidence identified.	No evidence identified.
Homelessness	Limited evidence but potentially higher risk of infection including with AMR.	No evidence identified.
Race/ethnicity	Significant variation in AMR by ethnic group (highest rates in Asian community). Unadjusted case fatality from AMR is highest in white ethnic group.	Mixed evidence on experience and access – especially on antimicrobial prescribing by ethnicity. Lower vaccine uptake among some ethnic minority groups leading to potentially greater reliance on antimicrobial treatments.
Criminal justice system	No evidence identified.	No evidence identified.

2 Introduction

This report summarises a review of the literature about antimicrobial resistance (AMR) and health inequalities. Where possible it focusses on the UK context. The UK's National Action Plan for AMR [2] identifies "What is the relationship between AMR and health disparities?" as one of the top ten AMR research priorities, recognising that more evidence is needed in this area.

As there is not extensive research available into AMR and health inequalities, we have included potentially lower quality data and have included caveats where findings should be treated with extra caution. Where relevant, sample sizes are included as endnotes to each chapter. The main text also identifies where research had a small sample size or focussed on a specific subset of people which might not be generalisable to the UK context. However, we have not undertaken a full assessment of the quality of evidence as the aim was to undertake a pragmatic review to identify what evidence exists, enabling people to deep dive into the audiences that are most relevant to them.

It is important to note that highest AMR burden is currently found in low and middle income countries, and as such it is vital that the worldwide response to AMR considers this. To just consider AMR in the UK context alone, or in the health service alone, would be to miss the wider factors that are contributing to this growing problem.

For the purpose of this report we have chosen to focus on the UK healthcare context to enable us to spotlight the health inequalities that are arising from AMR already in the UK, but we encourage readers to also be aware of the need for a One Health approach to AMR [3]. This approach is discussed in the UK National Action Plan for Antimicrobial Resistance [2].

Full details of the approach to the literature searches and inclusion criteria are included in Appendix 1. Note that UK Health Security Agency (UKHSA) is currently undertaking several rapid systematic reviews focussed on specific health inequality groups due to be published shortly including:-

- Abstracts of three of these reviews are available. They focus on adult social care (findings included below), individuals involved in sex work (which found no evidence to review) and those in contact with the criminal justice system (which was unable to draw conclusions due to limited evidence) [4].
- A rapid systematic review to assess antimicrobial use, antimicrobial resistance, and relevant antimicrobial stewardship interventions in people who use drugs, and a relevant review of refugees and asylum seekers are forthcoming.

The main report body is split into the following chapters:-

- Introduction including what is AMR and the importance of antimicrobial stewardship
- Prevalence, incidence, mortality, and long-term impact of AMR
- Access to, and experience of, healthcare, in the context of AMR

Each chapter has an overview and then takes the evidence for health inequality group in turn where information was available. Finally, in Appendix 2 the same data is restructured by inequality group (i.e. prevalence/outcomes, access, and experience for each group) for readers interested in a particular group.

2.1 What is antimicrobial resistance?

"Antimicrobial resistance (AMR) is one of the top global public health and development threats. It is estimated that bacterial AMR was directly responsible for 1.27 million global deaths in 2019 and contributed to 4.95 million deaths." [5] World Health Organisation

Antimicrobials are medicines used to prevent and treat infectious diseases. Antibiotics, antivirals, antifungals, and antiparasitics are all examples of antimicrobials. Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines, making infections difficult, or impossible, to treat.

According to WHO

"AMR is a natural process that happens over time through genetic changes in pathogens. Its emergence and spread is accelerated by human activity, mainly the misuse and overuse of antimicrobials to treat, prevent or control infections in humans, animals and plants." [5]

Currently, people in the UK experience relatively low rates of AMR (see 3.1). Equally, there are several 'last-resort' antibiotics which are still effective in the UK, although there is evidence worldwide that the effectiveness of these drugs is becoming compromised [5].

AMR is complex. It can develop in different ways [6]:

- natural resistance which might be intrinsic or always there.
- induced genes naturally occurring in the bacteria but only leading to resistance after exposure to an antibiotic.
- acquired e.g. through horizontal gene transfer between bacteria.

Resistance can take several forms including: limiting uptake of a drug; modifying a drug target; inactivating a drug and active drug efflux, where the drug is actively transported out of the cell [6].

AMR is contributed to whenever antibiotics are used, whether or not the use is appropriate. When a person takes antibiotics, all the bacteria they are carrying are exposed, not just the one they are being treated for and consequently have an opportunity to build resistance. This bystander effect contributes to AMR, even when antibiotics are being used appropriately [7].

At a population level, the aim to minimise antimicrobial resistance is approached through antimicrobial stewardship (see 2.3 below). However, some individuals have higher AMR risks than others. There are also public health considerations of access to clean **WA**ter, **S**anitation and **H**ygiene (WASH), and the use of vaccines which reduce the likelihood of catching a resistant strain [6]. The spread of resistance is facilitated through direct contact between humans, as well as between humans and animals or the environment, and through food [2].

The act of taking antibiotics will kill susceptible bacteria, but can leave behind any that are already resistant, making patients more susceptible to infection with opportunistic pathogens [7]. This can be a particular concern because people might carry small amounts of resistant bacteria asymptomatically, but killing the bacteria around it can lead to illness from the resistant strain. In addition, the genetic code for AMR can be passed from one bacteria to another when in close proximity [2]. This means that if an individual has resistant bacteria in their gut resistance could pass to other bacteria over time. This could increase their likelihood of experiencing illness from AMR bacteria. There is some evidence that taking antibiotics can lead to higher antimicrobial

resistance in an individual [8], especially in the first month after finishing the course [8], [9] and can impact for much longer [10].

AMR is impossible to capture in a single metric and is best understood in a matrix because there are a number of microbes that can cause illness, and there are a number of different types/families of antimicrobials that they can become resistant to. For example, the UKHSA has a regularly updated dashboard which reports on the rolling monthly average percent of *E. coli* bacteraemia resistant to a number of different antibiotic groups [11].

There is some evidence [12], [13] that where the NHS identified specific resistant bacteria to target, specifically Methicillin-resistant *Staphylococcus aureus* bacteraemia (MRSA) and *Clostridioides difficile* (*C. difficile*), observed infection rates fell significantly, although they appear to be starting to rise again.

One cause of AMR is Carbapenemase-producing Gram-negative organisms (CPOs) which are of particular concern as they are resistant to a class of antibiotics called carbapenems – broad spectrum antibiotics which have been relied upon as a last line of defence [14]. Since 2020, the NHS in England has collated quarterly data on samples taken which contain CPOs. Most, 71.7%, come from screening samples [15]. Samples are split into three types: sterile site specimens e.g. blood or cerebrospinal fluid; screening site specimens e.g. faeces or lower gastrointestinal tract; 'other' specimen types e.g. urine or lower genital tract [15]. Detailed demographic information is available within the dataset. NHS data about CPOs is detailed throughout Chapter 3.

There are five main carbapenemase families, NHS reporting uses the following acronyms:

- KPC (*Klebsiella pneumoniae carbapenem*).
- OXA-48-like (*Oxacillinase-48-like beta-lactamase*).
- NDM (*New Delhi metallo-beta-lactamase*).
- VIM (*Verone integron-encoded metallo-beta-lactamase*).
- IMP (*Imipenemase-Type metallo-beta-lactamase).*

2.2 What are health inequalities?

"Health inequalities are unfair and avoidable differences in health across the population, and between different groups within society. These include how long people are likely to live, the health conditions they may experience and the care that is available to them." [16] NHS England

This review sought evidence relating to the following characteristics, chosen as they include the protected characteristics as stated in the Equality Act, 2010, and to reflect Government guidance on health disparities and health inequalities (Oct 2022) – shown below [17].

Table 2: Protected Characteristics

- Age
- Sex
- Deprivation/employment/poverty
- Literacy/education and English not first language
- Gender / sexual orientation
- Pregnancy/marriage
- Race and ethnicity
- Religion / belief
- Asylum seekers / refugees
- Disability
- Mental illness & substance use
- Geography – urban/rural
- Homeless
- Criminal Justice system

There are two important considerations when reading this report. Firstly, that these characteristics are often found in combination, and this intersectionality can exacerbate health inequalities. The report addresses each characteristic separately; however, this might underrepresent inequalities experienced by individuals, owing to the interaction between characteristics.

Secondly, the ability to report on health inequalities relies on these characteristics being captured in the relevant datasets. NHS coding of demographic information, specifically ethnicity, is not consistent and therefore has the potential to introduce error into patients' records. Recent work by the Office for National Statistics has demonstrated that of those recorded as white British in health admin data sources, more than 96% reported the same ethnicity in the National Census. However, for Black and Mixed ethnicity records the level of congruence was significantly lower [18]. Missing or incorrect data might also apply for other demographic information, including disability [19] and other social determinants of health [20].

2.3 Antimicrobial stewardship

The term 'antimicrobial stewardship' is defined as 'an organisational or healthcare-system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness' [2]. AMS programmes typically include a range of activities to improve the selection of antimicrobial agents, dose, duration, and route, additionally avoiding antimicrobial use where possible [21].

It is important to note that human use of antibiotics is only one cause of antimicrobial resistance. Animal health, agriculture and the environment are also important contributing factors, which feature in the UK's National Action Plan (NAP) as part of a whole-systems or 'One Health' approach [2]. However, to manage the scope of this review, and because the focus is on health inequalities, the literature search and findings are largely focussed on human healthcare. As mentioned, (see Introduction) one of the stated outcomes in the NAP is "Health disparities and health inequalities –improve the information available to identify where the burden of AMR is greatest. This will help to target future interventions where they will have the greatest impact."

As concern about AMR increased, guidelines for the careful use of antimicrobials have been developed. Initially these guidelines focussed on the importance of completing the course of treatment, so that the disease being treated did not have an opportunity to develop resistance. However, more recently it has become accepted that it can be better to have shorter courses of treatment where evidence supports it and the patient recovers sooner [8]. There is now a wealth of guidance on appropriate use of antibiotics in the NHS in both primary and secondary care, as outlined below. The NAP also includes commitments to developing clinical decision support, behavioural interventions, and appropriate prescribing and disposal support [2].

2.3.1 Prescription guidelines

UKHSA, NICE and other collaborators are discussing options for continued production of the Summary of Antimicrobial Prescribing Guidance. In the interim, the Royal College of General Practitioners have produced a list of the conditions with links to available national guidance [22].

A 2019 study [8], using data from 2015, found that "For most common infections treated in primary care, a substantial proportion of antibiotic prescriptions have durations exceeding those recommended in guidelines." It also found that "in general, the preference seemed to be for antibiotic prescriptions with durations of five or seven days or multiples thereof, without a clear

evidence base for this preference." They hypothesised this could be driven by pack sizes or protocolised durations set in electronic prescribing software. They also suggested that the evidence base is relatively weak for the prescribing guidelines and discussed whether clinicians might not be confident following the guidelines as a result. The need to improve electronic prescribing support is identified as a recommendation in the 2025 NHS England digital vision for antimicrobial stewardship [23]. There are now trials emerging which are randomising duration of treatment to provide a stronger evidence e.g. a trial funded by National Institute for Health Research (NIHR) looking at treatment of urinary tract infections [24].

More recently, UKHSA looked at the impact of changing guidance on prescribing behaviour [25]. In September 2019, NICE published a guideline for the treatment of community-acquired pneumonia, recommending a course of amoxicillin and doxycycline for five instead of seven days. Between 2019 and 2023, for 500, 250 and 125 mg amoxicillin capsules, the proportion of prescriptions for a 5-day course increased steadily from 29.7% to 54.0%. Similar results for other changes in national guidelines were also found.

2.3.2 System level plans, guidelines and toolkits

The UK's National Action Plan for Antimicrobial Resistance 2024-2029 [2], has a target to reduce total antibiotic use in human populations by 5% (from a 2019 baseline) and to increase the proportion of narrow spectrum antibiotics used to 70% of total use by 2029. To support this NHS England developed a digital vision for antimicrobial stewardship [23], promoting digital systems to support primary and secondary care clinicians. This document outlines recommendations for a range of stakeholders including users, commissioners and software suppliers.

The digital vision also signposts to the UKHSA toolkit [7]. This includes instructions to start smart - assess, investigate, prescribe and document - and then, after 48-72 hours, focus by reviewing and revising the clinical diagnosis as necessary. The five antimicrobial review outcomes are remembered by the acronym 'CARES' – to cease, amend, refer, extend or switch. This toolkit mentions the need to consider "patients with factors commonly associated with health inequalities where appropriate." However, no further information is provided about what this might mean in practice.

2.3.3 The impact of vaccination

Another important consideration is vaccination uptake [26]. Some important diseases associated with AMR such as Tuberculosis (TB) and *Streptococcus pneumoniae,* can already be prevented using vaccines. There are many more vaccines in development which could further reduce the need for antibiotic treatments [27]. Groups who are less likely to have these vaccines, are both more likely to need antibiotics to treat such diseases, and potentially at greater risk of dying due to an antimicrobial resistant strain. According to the TB Alliance [28] "While AMR is often associated with hospital-based infections, like MRSA, about 29% of deaths caused by antimicrobial infections today are due to drug-resistant TB." While this statistic is based on worldwide cases, nonetheless, the WHO emphasises the importance of vaccination in reducing AMR [26].

2.3.4 International context

AMR is one of the top global public health and development threats and four organisations – the WHO, the Food and Agriculture Organisation of the United Nations, the UN Environment Programme and the World Organisation for Animal Health - are working together to coordinate a

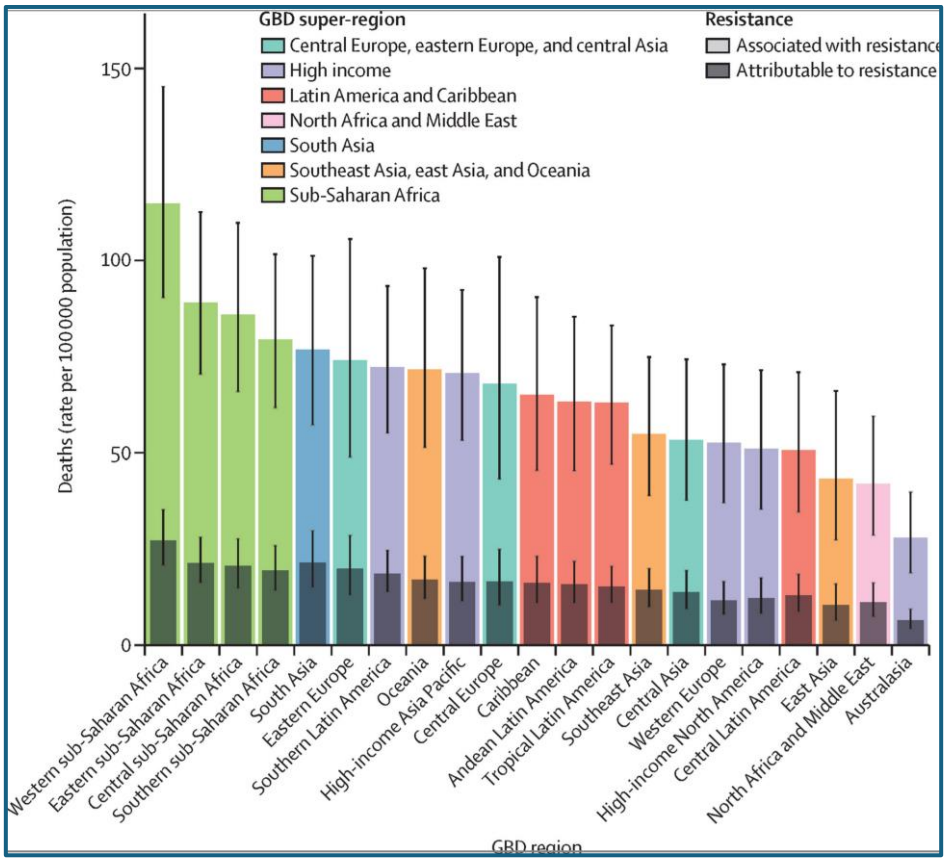
One Health global response [5]. To improve access to appropriate treatment and reduce inappropriate use of antibiotics, WHO developed the AWaRe (Access, Watch, Reserve) classification of antibiotics. The WHO AWaRe antibiotic book [29] provides evidence-based guidance on the use of antibiotics for common clinical infections. The multisectoral annual Tracking AMR Country Self-Assessment Survey (TrACSS) was launched in 2016. The most recent return [30] shows the UK performing better than the global average on all measures except - raising awareness and understanding of AMR risks and response - where it lags behind.

3 Prevalence, incidence, mortality, and long-term impact

3.1 Overview

According to the WHO, antimicrobial resistance is one of the top global public health and development threats [5]. In 2019, estimates suggest that bacterial AMR was directly responsible for 1.27 million global deaths and contributed to 4.95 million deaths overall [5]. More recent data suggests cases fell slightly during the COVID-19 pandemic, but they are forecast to rise again without additional measures [31]. AMR deaths are not distributed equally. While it affects all countries and regions, low and middle income countries are currently most affected [5], as shown in Figure 1.

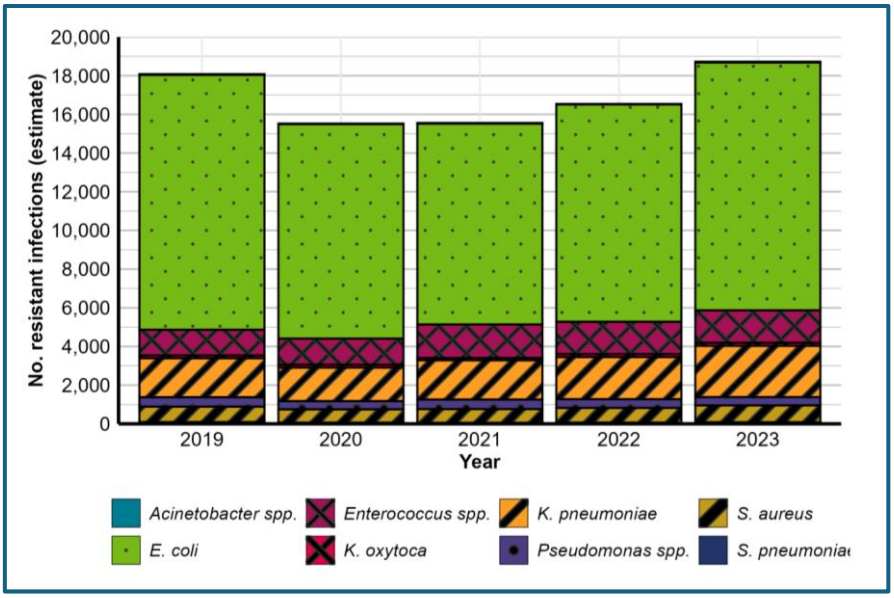
Figure 1: Estimated deaths per 100,000 by world region [32]



In high income countries, the most common pathogens leading to deaths attributable to or associated with AMR [32] are ***Staphylococcus aureus*** (often associated with skin infections [33])

and ***Escherichia coli*** (abbreviated to '*E. coli*', associated with food poisoning [34] and UTIs [5]). In 2023, according to the UK HSA Enterobacterales (including *Klebsiella pneumoniae* and *oxytoca, and E. coli*) comprised 83% of the AMR burden (see Figure 2). Gram-positive organisms (*Enterococcus spp.*, *Staphylococcus aureus* and *Streptococcus pneumoniae*) comprised 14% [25]. The Organisation for Economic Cooperation and Development (OECD) suggests that resistant infections acquired in healthcare settings are particularly likely to lead to mortality. These infections account for about one in three resistant infections, but represent more than 60% of AMR-related deaths worldwide [35].

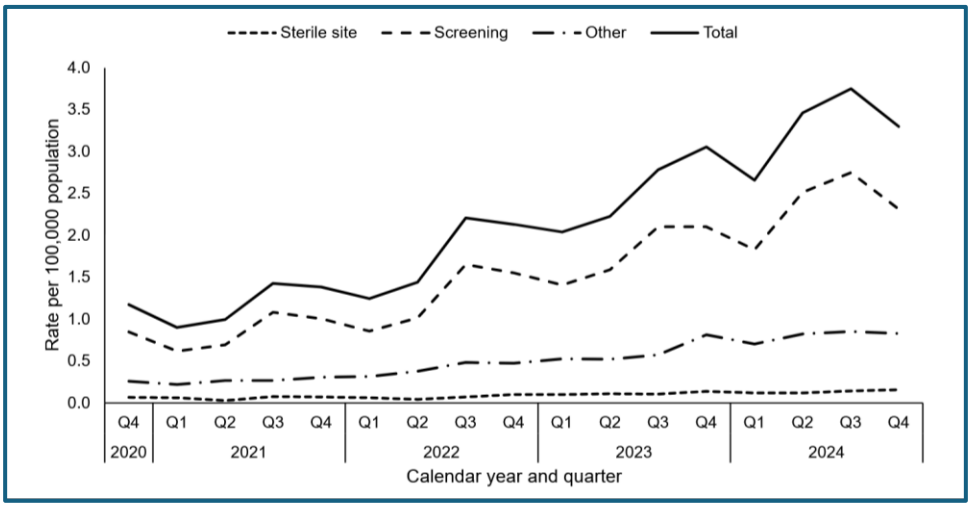
Figure 2: Annual estimated total of the burden of antibiotic resistant bacteria episodes in England 2019-2023 [25]



The UK, along with some countries in Western Europe, Scandinavia and Canada have relatively low levels of resistance [32]. Some research suggests that countries with higher levels of income inequality also have higher levels of antimicrobial consumption, and antimicrobial resistance, although the paper only demonstrates a correlation not causation [36]. The WHO notes that HIV and TB drug resistance are important to monitor as AMR makes existing treatments less effective [5].

As noted in section 2.1, the NHS monitors acquired carbapenemase-producing organism (CPO) episodes. Figure 3 shows that, despite an apparent seasonal variation in the observed rates, there is an upward trend over time. As reporting is relatively new, this might also be a result of changing screening policies and increased reporting over time. However, between 2018 and 2023, the estimated number of severe antibiotic-resistant infections in England has risen overall, despite a target to reduce by 10% from the 2018 baseline by 2025 [25].

Figure 3: Quarterly rate of acquired CPO episodes by specimen type in England [15]



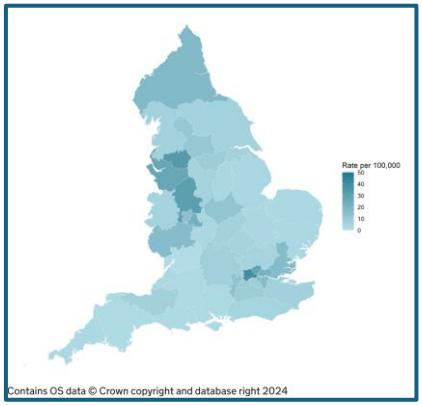
According to the UKHSA [25], in 2023, the overall crude case fatality rate for 30-day all-cause mortality in patients with selected (*E. coli, K. pneumoniae, Acinetobacter spp.* and *Pseudomonas spp.*) Gram-negative bacteraemia was 15.5%. All-cause mortality was significantly higher for patients infected with a strain resistant to one or more AMR burden-defined antibiotics (16.9%), compared to those with a susceptible strain (15.1%). Thirty-day all-cause mortality in the context of a carbapenemase-producing organism infection from a sterile site was 22.9%.

In conclusion, the prevalence and incidence of AMR are known at a population level. However, according to the UK's National Action Plan [2] "There remain large gaps in understanding and knowledge of how infection incidence, antibiotic use and clinical outcomes differ between populations." This report sets out what is known, but there are many gaps.

3.1.1 Geography

The NHS CPO screening data demonstrates that acquired CPO incidence rates vary by region, with particularly high rates in London and the North West (especially North West London and Greater Manchester) – shown in Figure 4 [15]. This might in part reflect different outbreaks, or approaches and policies relating to screening and reporting.

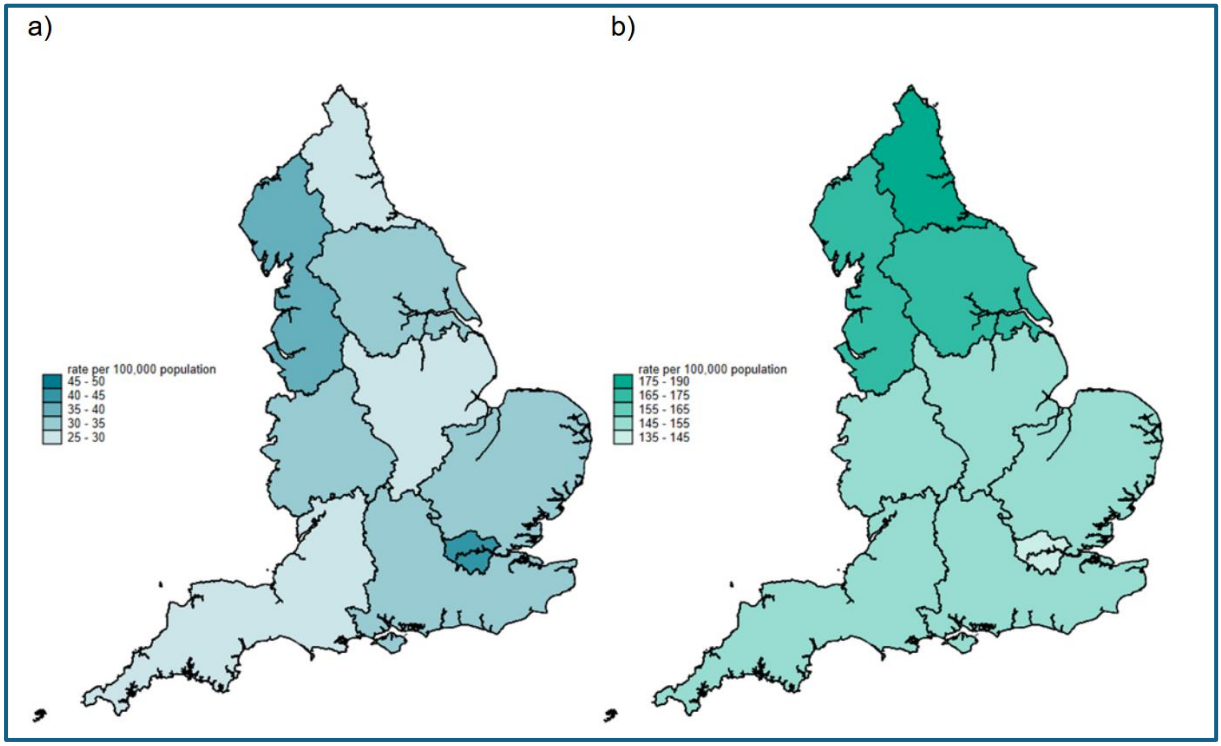
Figure 4: Integrated Care Board (ICB) regional distribution of acquired CPO annual incidence rates per 100,000 population (England): January 2024 to December 2024 [15]



A similar pattern is identified in the UKHSA English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR) report [25]. However, while the highest AMR burden is located

in London and the North West, the estimated numbers of all bacteraemia (the presence of bacteria in the blood whether or not resistant to antimicrobials) are highest in the North East, based on data from screening samples – shown in Figure 5.

Figure 5: Regional variation in the rate per 100,000 of a) estimated burden of AMR and b) estimated numbers of bacteraemia in England in 2023 [25]



3.1.2 Migrant communities

The academic literature relating to AMR prevalence among different groups is very limited. The most consistently identified group in the literature identified in this review related to AMR in migrant communities. This has been attributed to a range of factors including:

- higher risk of transmission during migration.
- host country transmission due to social factors like overcrowding in refugee camps or other accommodation.
- disrupted access to healthcare.
- poor access to water, sanitation and hygiene [1].

One study from the Netherlands found that the impact of picking up a resistant strain can be long-lasting: AMR carriage in asylum seekers showed no particular decline more than a year after arrival [37].

A 2023 systematic review and meta-analysis of AMR in migrants in Europe [38] found that the pooled prevalence for any detected AMR was 28.0%, compared to 25.4% in 2017. This change may, or may not, be significant[a] due to wide confidence intervals. The authors assert this is a 'high' rate but do not attempt to produce a comparison with the general population in the host countries, country of origin or transit. Their analysis found AMR was more common in community

[a] For the estimate of 28.0% the 95% confidence interval was between 18.0%–41.0%

settings (such as refugee camps, transit hubs and detention centres) rather than in hospitals for people living in large migrant populations. The authors found "it remains unclear whether migrants bring resistant organisms from their country of origin, or whether they acquired the organism in transit, or in refugee centres." This review also found no evidence of a link between AMR acquisition and arrival time or length of stay.

Qualitative research with migrants in the UK [39] found several reasons why migrants may be more at risk acquiring and transmitting diseases, including AMR. These included:

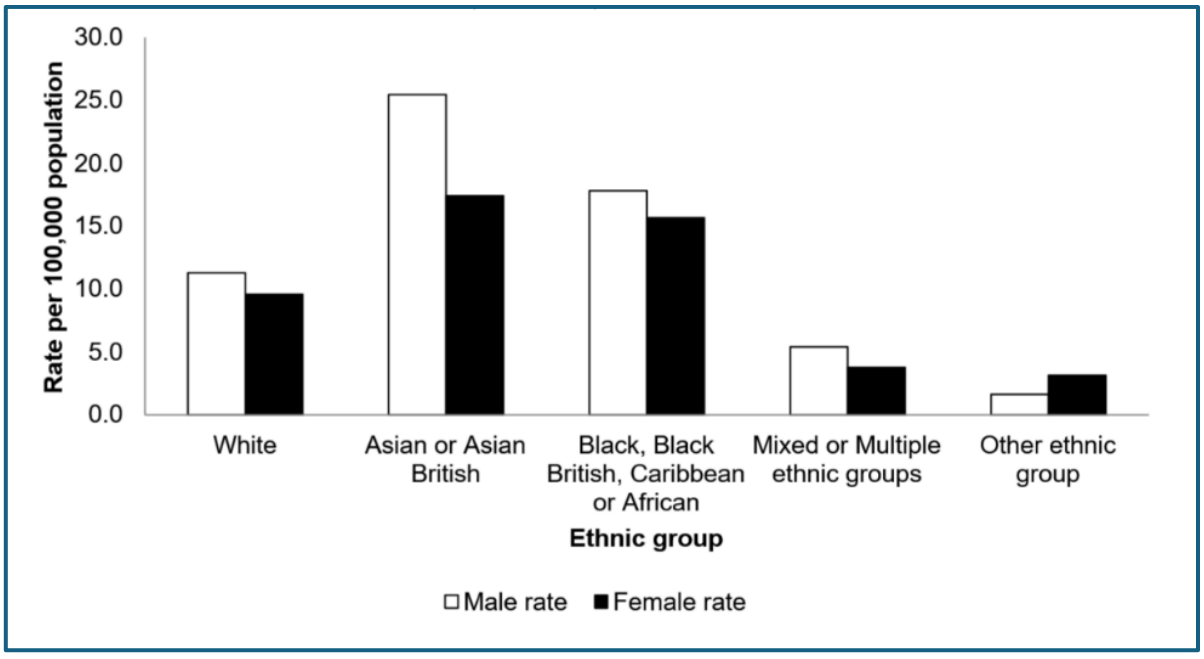
- living conditions during the journey to the UK, especially for those entering the UK without a visa.
- living conditions in temporary accommodation in the UK, including shared accommodation and hotels.
- difficulties accessing clean water and sanitation, both on the journey, and in the UK.

Similarly, people in institutional settings, such as migration centres, can be at risk of spread and outbreaks of infectious diseases, including infections from geographic regions with high resistance prevalence [2].

3.1.3 Ethnicity

As shown in Figure 6, the NHS CPO data demonstrates that incidence rates vary by ethnic group, with the highest annual rate reported in those of Asian or Asian British ethnicity, followed by people of Black or Black British, Caribbean or African ethnicity [15]. The data also shows that different ethnic groups have a different distribution of CPO families – NDM is most common in individuals of Asian ethnicity (55.3% of episodes reported), while KPC is rare in people of Asian ethnicity (5.1% of episodes), but appears more frequently in people of White ethnicity (25.9% of episodes). OXA-48-like episodes account for approximately one third of cases in each ethnic group.

Figure 6: Annual rate of acquired CPO episodes per 100,000 population by ethnic group based on notifications to UKHSA by all diagnostic laboratories in England [15]



According to UKHSA [25], as shown in Figure 7, the pattern is similar for AMR bacteraemia burden by ethnic group: Asian or Asian British people have the highest AMR burden, while White and Mixed race ethnicities are lower (the difference is not statistically significant). The resistance categories considered include eight bacteria (those listed above and MRSA), and four or more different classes of antibiotics [40].

Figure 7:AMR bacteraemia burden by ethnic group in England (2023) [25]

Ethnic group	Rate of bacteraemia per 100,000 population (n)	Rate of resistant bacteraemia per 100,000 population (n)	Percent resistant (95% confidence intervals)
White	146.7 (71,457)	29.5 (14,365)	20.1% (19.8 to 20.4)
Asian or Asian British	84.5 (4,659)	33.3 (1,835)	39.4% (38.0 to 40.8)
Black, African, Caribbean or black British	104.0 (2,505)	27.5 (663)	26.5% (24.8 to 28.2)
Mixed or multiple ethnic groups	37.9 (651)	8.4 (145)	22.3% (19.1 to 25.5)
Any other ethnic group	23.9 (300)	4.4 (55)	18.2% (13.9 to 22.6)
Not known or Not stated	N/A (1,304)	N/A (208)	16.0% (14.0 to 17.9)

* 6,130 (7.6%) bacteraemia episodes could not be linked to obtain ethnic group information. The percentage resistant in this group was 19.8% (n=1,212).

However, despite the higher AMR burden in ethnic minority groups, of those patients for whom ethnicity was reported, the same report [25] found that the crude, unadjusted case fatality rate for patients infected by Gram-negative organisms was highest in the White ethnic group (16.2%) and lowest in Mixed or multiple ethnic groups (9.5%). Separate analysis showed patients infected with *E. coli* or *K. pneumoniae* strains resistant to one or more AMR burden-defined antibiotics had a statistically significant higher crude case fatality rate, compared to those with a susceptible strain (16.1% vs 14.0% respectively).

3.1.4 Poverty and deprivation

People living in the most deprived areas, compared to those living in the least deprived areas, have emergency admission rates that are:

- twice as high for infectious respiratory diseases.
- twice as high for invasive infections and
- 1.7 times higher for infectious gastrointestinal diseases [41].

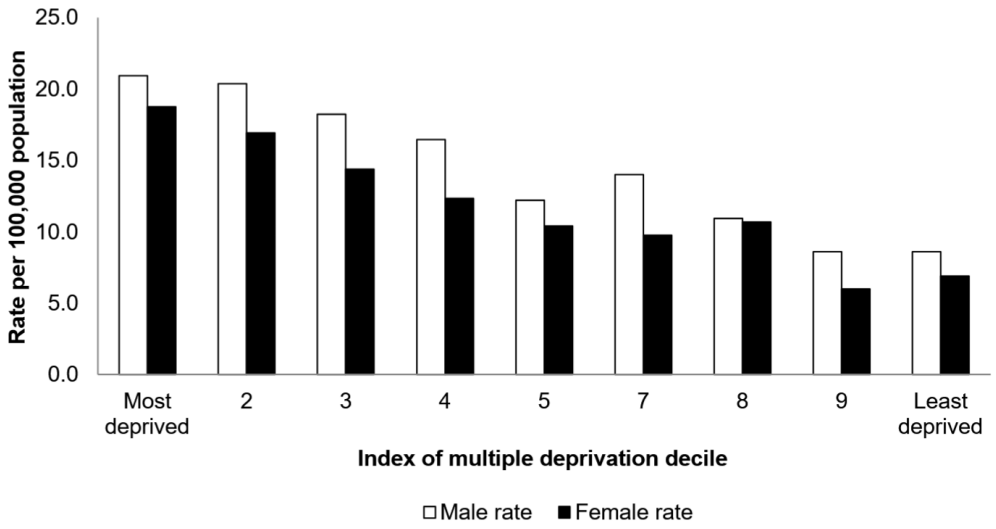
In this context, the UKHSA's ESPAUR report [25] notes that AMR burden varies by Indices of Multiple Deprivation (IMD). Nationally, the highest AMR burden rates were seen in the most deprived populations of England. The report also notes that the difference between the most and least deprived widened between 2019 and 2023. Case fatality rates from Gram-negative organisms in the most and least deprived IMD quintiles were the same (15.6%). However, the estimated number of deaths was 30.8% higher in the most deprived quintile (est.=1,701) than in the least deprived quintile (est.=1,300), driven by higher numbers of infections – shown in Figure 8.

Figure 8: AMR bacteraemia burden by IMD quintile in England [25]

IMD quintile	Rate of bacteraemia per 100,000 population (n)	Rate of resistant bacteraemia per 100,000 population (n)	Percent resistant (95% confidence intervals)
1 (most deprived)	173.5 (19,601)	38.1 (4,301)	21.9% (21.4 to 22.5)
2	157.3 (18,299)	34.1 (3,963)	21.7% (21.1 to 22.3)
3	149.8 (17,201)	31.0 (3,559)	20.7% (20.1 to 21.3)
4	145.1 (16,219)	30.2 (3,376)	20.8% (20.2 to 21.4)
5 (least deprived)	130.9 (14,338)	26.7 (2,925)	20.4% (19.7 to 21.1)

The NHS CPO data (see Figure 9) demonstrates a clear relationship between CPO episodes and IMD (measured using a set of factors that includes their levels of income, employment, education and local levels of crime). CPO episodes are more likely to be reported in the most deprived parts of the country.

Figure 9: Annual rate of acquired CPO episodes per 100,000 population by index of multiple deprivation decile and sex (2024) [15]



A systematic overview of reviews for Public Health England [42] found "the evidence consistently shows that those with lower level of income, lower educational attainment, unemployment, higher area level deprivation, lower socioeconomic status or poor living situations are at higher risk of infectious diseases, AMR, and lower vaccine uptake."

An American study [43] concluded that "Poverty probably plays a role in antimicrobial resistance within the United States as well, but little research has occurred in this area."

3.1.5 Sex

NHS CPO data shows overall the annual rate was higher in males compared to females (overall rates of 14.5 and 11.5 episodes per 100,000 population) [15]. However, the literature reviewed did not include any other data relating to sex or gender and prevalence of AMR except one study that found variation by age-group [44].

There are a few more narrowly focussed findings. For example, a review found pregnancy and childbirth heighten the risk of infections, resulting in the use of antibiotics for both therapeutic

and prophylactic purposes [6]. The same report stated women are usually at a higher risk of contracting UTIs, but there is no evidence that these differences lead to higher AMR. In fact, a study by the London School of Hygiene & Tropical Medicine [44] found that in general males had a higher risk of AMR than females[b]. Similarly, one systematic overview of reviews [42] found several suggesting higher prevalence of infectious diseases and AMR among men who have sex with men, although the studies referenced focus on a couple of specific resistant diseases rather than AMR as a whole.

3.1.6 Age

The literature reviewed consistently suggest that infections associated with AMR form a U-shaped curve, with the highest prevalence in the youngest and oldest patients. This pattern can also be seen in AMR specifically, but the pattern varies depending on both specific bacteria and specific antibiotic [44]. An important exception to the U-shape is *E. coli*, for which research looking at age and sex found elevated infection incidence in females between the ages of 15 and 40 [44]. To give another specific example, in the winter of 2022 to 2023, children were at particularly high risk of infection of Group A *Streptococcus* in the UK. Generally, older adults are more susceptible to AMR related illnesses, potentially due to their higher incidence of infections and comorbidities [2].

A global study [31] found AMR mortality rates are changing, and that for children under 5 years old there was a 50% reduction in mortality between 1990 and 2021, whereas for adults the mortality rate has increased. These improvements for children are largely attributed to vaccination programmes and improved access to WASH. In contrast, AMR mortality increased by over 80% among adults over 70 years old in the same period.

In the UK, the UKHSA [25] found that the number and rate of both bacteraemia and resistant bacteraemia were highest in the over 74 years age group, followed by the 65 to 74 age group and the youngest age group (<1 year old). It concluded "Between 2019 and 2023, rates of reported bacteraemia in children aged 0 to 17 years increased from 118.5 to 148.6 per 100,000 population[c]. Figure 10 shows that bacteraemia rates were highest in children aged under one year. In 2023, in under one year olds , half of the bacteraemia episodes occurred in infants that were older than one month, and half in infants younger than one month (with 19.6% occurring in 0-to-3-day olds and 30.4% in 4-day- to one-month-olds)."

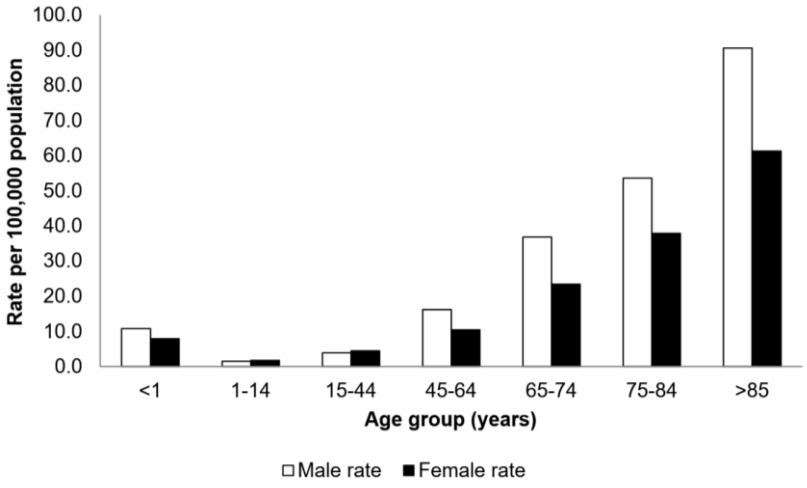
[b] A total of 6,862,577 susceptibility results from isolates with age, sex, and spatial information from 944,520 individuals were used to characterise resistance prevalence patterns for 38 different bacterial species and antibiotic combinations. A total of 349,448 isolates from 2019 with age and sex metadata were used to calculate incidence.
[c] (n=13,973 to 17,663)

Figure 10: AMR burden from bacteraemia by age group in England in 2023 [25]

Age group (years)	Rate of bacteraemia per 100,000 population (n)	Rate of resistant bacteraemia per 100,000 population (n)	Percent resistant (95% confidence intervals)
Under 1	285.1 (1,652)	49.2 (285)	17.3% (15.4 to 19.1)
1 to 4	35.1 (870)	5.1 (128)	14.7% (12.3 to 17.0)
5 to 9	12.3 (411)	1.7 (56)	13.6% (10.3 to 16.9)
10 to 14	13.5 (462)	1.8 (62)	13.4% (10.3 to 16.5)
15 to 44	37.5 (8,122)	7.5 (1,619)	19.9% (19.1 to 20.8)
45 to 64	127.0 (18,506)	26.4 (3,845)	20.8% (20.2 to 21.4)
65 to 74	311.8 (17,359)	68.6 (3,819)	22.0% (21.4 to 22.6)
Over 74	830.0 (40,684)	183.8 (9,008)	22.1% (21.7 to 22.5)
Unknown	0.0 (19)	0.0 (6)	29.4% (9.0 to 49.9)

Equally, NHS data shows CPO incidence is highest for the oldest and youngest members of the population [15] – shown in Figure 11. The highest annual rate reported was for people aged 85 years and over (72.4 per 100,000 population) followed by those aged 75 to 84 years (45.1 per 100,000 population). For infants less than one year old, the CPO annual incidence rate was 9.4 per 100,000 population.

Figure 11: Annual rate of acquired CPO episodes per 100,000 population by age and sex (data from 2024) [15]



As outlined above, the overall case fatality rate for 30-day all-cause mortality in UK patients with selected Gram-negative bacteraemia (*E. coli, K. pneumoniae, Pseudomonas spp., Acinetobacter spp.*) was 15.5% in 2023. This varied by age: fatality was lowest in children aged 1 to 14 years (4.4%) and highest in adults aged 85 years and over (21.8%) [25].

3.1.7 Disability, long-term conditions, and living in care

The National Action Plan [2] states that "Several different groups are more vulnerable to infection and resistance, including people with disabilities and people in high risk settings" but does not

provide a reference for this statistic. Several studies have found that care home residents have higher rates of antibiotic-resistant infections than older people living in their own homes [45].

3.1.8 Drug use

People who inject drugs are also likely to be at disproportionately high risk of invasive bacterial infections, including bacteraemia due to MRSA, *Methicillin-Susceptible Staphylococcus Aureus* (MSSA) and Invasive Group A *Streptococcal* infections [41]. This could be due to unsterile injecting, and barriers to accessing care [46]. However, there is a lot of missing data in NHS datasets which means it is difficult to assess this accurately [46]. The literature reviewed did not find information relating to AMR specifically.

3.1.9 Homelessness

A systematic overview of reviews [42] found several studies that demonstrated a higher risk of various infectious diseases, or AMR, among people experiencing homelessness compared with those who were not homeless. Similarly, a report on infections among people who inject drugs, suggests that homelessness may contribute to risk of infection [46].

4 Access to, and experience of, healthcare

4.1 Introduction

A 2023 systematic review for UKHSA [29] concluded "factors associated with health inequalities are not routinely considered during the implementation and evaluation of interventions to improve health-care professionals' interaction with patients." Another UKHSA review found there was a scarcity of published and evaluated resources addressing factors associated with health inequalities related to AMR [25]. Therefore, it is not surprising that the literature reviewed found limited evidence, and what we found mainly relates to antibiotic prescribing. There was also some information about vaccination uptake which is relevant as some vaccines prevent illnesses which would otherwise be treated with antimicrobials [2].

The UK's National Action Plan [2] includes a commitment to collate cost-effective, evidence-based resources for identifying and addressing health inequalities in access, infection incidence, clinical outcomes, vaccine uptake and antimicrobial exposure in different areas. It notes that:

> *"The inequality observed in the outcomes from infection follow the same patterns as for non-communicable diseases, such as heart disease, mental ill health and cancer…However, there are still specific points in the patient infection pathway where there are opportunities to intervene to reduce health disparities…Interventions will be designed to recognise and address the different challenges that different groups, settings and localities might face. Action at a local level will be necessary to effectively mitigate the threat of AMR."* UK National Action Plan [2]

According to the UKHSA [25], in 2023, use of antibiotics increased in all primary and secondary care settings, except dental practices. Penicillins remained the most frequently used antibiotics, but increases in consumption were observed for the majority of antibiotic groups. This is despite ongoing commitments to reduce prescribing in line with antimicrobial stewardship goals. Over

the past five years antibiotic use in the primary care setting accounted for approximately 80% of total consumption across the healthcare system [25].

Harvey et al. produced a thorough review looking at factors commonly associated with health inequalities and links with antibiotic dispensing, prescribing and reported use in high-income countries [41]. It found that many schemes have been trialled in England to improve antimicrobial stewardship, but the learning was not systematically shared across the country. It also found that there is evidence to suggest that electronic decision support tools (supported by evidence from systematic reviews) could lead to safe and moderate reductions of antimicrobial prescribing. Leaflets for parents/carers of children explaining 'When should I worry', and C-reactive protein point-of-care testing were also shown to lead to improvements. However, the review focused on actions that *could* be taken rather than patient's access to, and experience of, healthcare and so are outside the scope of this report.

In line with the findings above (Section 3.1.1) the Policy Innovation and Evaluation Research Unit evaluation of the first AMR National Action Plan found that in addition to providing evidence-based guidelines for prescribing, consideration should also be given to local variation. This was to include geography, and population socioeconomic factors, which can affect the need for antimicrobial prescribing, especially in more deprived areas [2]. A quick check of three London Integrated Care System Antimicrobial Prescribing Guidelines for Primary Care [47], [48], [49] found mention of the need to "consider local antimicrobial resistance and surveillance data" but did not explain further or provide links.

Literature about reducing antimicrobial prescribing identified for this review mostly considered reducing prescribing generically, without mentioning health inequalities. Even papers which look at inequalities in incidence and outcomes of AMR and antibiotic prescribing do not necessarily go upstream to examine the causes, or potential mitigations [50]. The literature reviewed did not include any studies which explicitly referenced the different rates of AMR in different communities which might indicate the need for different approaches to diagnosis or prescribing, beyond guidance acknowledging the need for local variation [2].

Research into the factors contributing to over-prescribing include the prescriber's view of what the patient will want or expect [51] [52]. Consequently, it is useful to explore whether there are differences in expectations between groups and these are highlighted below.

4.1.1 Geography

Data about antibiotic consumption [25] demonstrates that although London experiences the greatest AMR burden, prescription of antibiotics in both primary and secondary care are lower. UKHSA suggest this could be due to differences in access. Prescriptions of antibiotics (measured in Daily Defined Doses per 1,000 inhabitants per day) are highest in the North East and North West. The literature reviewed did not explain whether high levels of antibiotic prescription and higher levels of AMR were causal (in either direction), correlated or coincidental. There is some evidence from the USA that reducing broadly distributed, low-intensity antibiotic use could be more effective than reducing high-intensity use to minimise AMR [53].

4.1.2 Migrant communities

Qualitative research [39] has found that there are a number of barriers for migrants seeking access to healthcare when they need it. This could be a problem throughout their journey to the UK, but also when in the UK. Barriers within the UK included: not knowing how to navigate the NHS,

experiencing long waits and finding it difficult to find (or trust) an interpreter. The migrants also discussed financial barriers to both buying essentials to maintain hygiene and to pay for prescription drugs if they were needed. Some of the participants in the study had obtained antibiotics without a prescription to bring with them to the UK, because they were concerned about their ability to access healthcare. This could lead to them being used inappropriately.

A review [54] found other studies have also shown that the NHS Charges to Overseas Visitors Regulations might lead to fears of charging and data sharing; factors which are known to deter some migrants from accessing healthcare. However, it also noted that evidence was lacking. In the UK, data sources commonly used for tracking and researching AMR do not include information about who is a migrant, limiting potential analysis.

4.1.3 Ethnicity and religion

The literature reviewed highlighted the importance of country context when exploring ethnicity and antibiotic use [55]. Consequently, this review focusses on data about ethnic minority groups living in the UK where antibiotics are only available through prescription at a relatively low financial cost to the patient.

In a 2020 study, prescribing data from NHS GPs[d], suggested that there were higher levels of antibiotic prescribing in areas with a greater proportion of people of White ethnic origin [56]. However, a qualitative study with Clinical Commissioning Groups (CCGs) and GPs in England [57] considered deprivation and ethnic minority populations together. In interviews people from ethnic minority groups (and from areas with higher levels of deprivation) were perceived as needing more antibiotics. This was after considering the wider context of their lives, including their perceived ability to self-care, reconsult, their risk of complications, and the impact of not working.

As outlined in section 4.1, patient experience can be influenced by prescribers' perceptions of what the patient wants [51] [52]. This might include prescribing antibiotics outside of the guidelines. A nationally representative survey[e] for UKHSA [58] found that people from ethnic minority groups were, compared to White people were:

- more likely to have taken antibiotics in the past 12 months.
- less likely to believe they could personally do anything to prevent antibiotics becoming less effective.
- slightly more concerned about AMR for them personally.

This finding is consistent with a previous 2017 English survey [59] where Black, Asian and minority ethnic adults were also found to be less knowledgeable about antibiotics[f].

Vaccine uptake

Vaccine hesitancy among ethnic minority groups might also lead to higher prevalence of AMR in these groups. A European systematic review [60] found that under-vaccinated groups include Orthodox Protestant communities, Anthroposophists, Roma, Irish Travellers, and Orthodox

[d] Antibiotic prescribing data were obtained from the NHS Business Services Authority ePACT2 system. The data were downloaded for English General Practices (GPs) for the 4 years from April 2014–March 2015 to April 2017–March 2018. All GP practices open for the entire year were included in the analysis

[e] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024

[f] The main survey was undertaken in January 2017 (n=1691); data from an additional sample of parents were collected in April 2017 (n=592). Analyses were weighted to obtain estimates representative of the population.

Jewish communities. This study found that the most frequently mentioned shared reasons for not vaccinating their children were:

- the perceived non-severity of the disease.
- the perceived un-safety of the vaccine e.g. the fear of side effects and misconceptions.
- the need for more information, or the lack of information about, for example ‚risks of vaccination".

An NHS report [61] produced to support COVID vaccine uptake found significantly lower vaccination rates in ethnic minority groups, especially Black people, but also Bangladeshi and Pakistani people.

A working paper for the SAGE Committee of the World Health Organisation [62] attributed lower vaccination rates to a number of factors including:

- contextual influences e.g. religion/culture/gender/socio-economic, communication and media environment.
- individual and group influences e.g. personal experience with vaccination, health system and providers trust.
- vaccine/vaccination specific issues e.g. risk/benefit, epidemiologic and scientific evidence, mode of delivery, costs.

As noted in 3.1.3, the presence of NDM-producing organisms differs by ethnic group, and they are more common in people from Asian and Black ethnic groups. According to UKHSA [25], these organisms are some of the most resistant and challenging organisms to treat, with extremely limited treatment options. The literature reviewed did not look at how many patients received the most appropriate treatment option first time i.e. not trying to treat a patient with an antibiotic to which they or their infection were resistant.

4.1.4 Poverty and deprivation

As noted in section 3.1.4, there are higher rates of infectious diseases and AMR in areas with high deprivation. There is a positive association between increasing level of deprivation and increasing rates of antibiotic use in primary care [25]. The UKHSA ESPAUR report states that in 2023 the rate of total antibiotic use for the most deprived quintile was 69.1% higher than the rate of use in the least deprived quintile, and the gap had increased since 2019. The report also showed that broad spectrum antibiotic use was higher in the most deprived areas, although the difference in the proportion of broad spectrum use between the most and least deprived areas is falling. Other studies have looked at whether differences in prescribing can be explained by comorbidities or smoking[g] [63], or after adjusting, using a proxy indicator of health need [56] (the proportion of patients with COPD and diabetes).[h] The conclusion was that such variables could explains some, but not all, variance.

It is hypothesised that higher prescription rates in areas with higher deprivation reflect both differences in healthcare quality and access, and also underlying differences in the population health needs [56]. For example, more deprived areas have lower GP provision per head and are more reliant on locum doctors.

[g] Study used publicly available data from 7376 general practices in England between April 2014 and March 2015 were used.
[h] Overall, 29,631 GP surgeries were included in the analysis for antibiotic prescribing over the 4 years for which data were available for the 4 years from April 2014–March 2015 to April 2017–March 2018 (representing 7700 unique surgeries).

Qualitative research with people from CCGs and GPs [57] suggested the following could lead to higher antibiotic prescribing in areas which are most deprived:

- more illness and comorbidities overall.
- less perceived ability to self-care, and or access to over-the-counter remedies in those areas.
- patients living in those areas having a lower threshold for seeking GP appointments and antibiotic treatment i.e., patients consulting earlier in the illness, expecting antibiotics and needing to get back to work.
- people having a greater need for illness validation e.g., sick notes and quicker recovery.

4.1.5 Rural and urban areas

A study based on NHS GP prescribing data from 2014-2018, demonstrated that GPs in rural areas showed higher rates of antibiotic prescribing than those in urban locations [56]. An American study hypothesised this could be due to decreased access to care or difficulties getting to the health service, and limited access to diagnostic equipment [64] (although distances are likely to be far longer in the USA).

4.1.6 Sex and pregnancy

The only literature identified relates to antibiotic use rather than experiences of AMR specifically. According to several reviews looking at high income countries [56] [66] most studies report higher antimicrobial prescribing for women patients compared with men. This may be largely driven by the use of antibiotics to treat UTIs [55]. However, they also found that there is some evidence that women admitted for severe sepsis or septic shock wait longer for antimicrobials than men do. [28].

As outlined in section 4.1, patient's experiences can be influenced by prescribers' perceptions of what the patient wants. This might include prescribing antibiotics outside of the guidelines. A nationally representative survey[i] for UKHSA [58] found that men and women were equally likely to:

- have taken antibiotics in the past 12 months.
- believe they could personally do something to prevent antibiotics becoming less effective.
- be concerned about AMR for them personally.

The guidelines for antimicrobial prescribing have been adjusted over time, typically to reduce the length of the course of treatment. According to a study [8] based on NHS data from 2015, for most common infections treated in primary care, a substantial proportion of antibiotic prescriptions had durations exceeding those recommended in guidelines. In particular, for respiratory conditions and acute cystitis among females. This study also found that men were receiving antibiotics for shorter than recommended durations for UTIs, which the authors believed could indicate a risk of harm from under-treatment.

An American study found that younger pregnant women used more antibiotics than older pregnant women [66]. No UK data about access and experience of antibiotic use, or AMR, was identified in the literature reviewed.

[i] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024

4.1.7 Age

In 2023, the highest rate of antibiotic use in primary care continued to be in adults aged over 65 [25]. Other studies have also shown that adults in older age groups, especially those in residential care, have the highest antibiotic use [55]. An American review [65] found that "in the outpatient setting, (antimicrobial prescribing) tends to be high in infants, decreases in older children and young adults, increasing again in the elderly." This reflects the U-shaped curve for cases of infection, outlined in section 3.1.6.

A 2015 study based on NHS data, found that for most common infections treated in primary care a substantial proportion of antibiotic prescriptions had durations exceeding those recommended in guidelines. It found no large differences in antibiotic prescriptions between children and adults [8].

As outlined, patient's experiences can be influenced by prescribers' perceptions of what the patient wants [51] [52]. A nationally representative survey[j] for UKHSA [58] found that younger people (aged 16 to 24 years old) were more likely to have taken antibiotics in the past 12 months, were equally likely to believe they could personally do something to prevent antibiotics becoming less effective, and were less likely to be concerned about AMR for them personally than people aged 65+ years. A 2017 survey in England [59], showed the youngest (15–24 years) and oldest (over 65 years) were less knowledgeable about antibiotics[k].

While there appear to be few differences in access or experience of AMR by age in the literature identified, there is some evidence that exposing a child to antibiotics may affect normal immune development and so lead to greater susceptibility to infections later in life [67]. This may mean that equal treatment might not lead to equal outcomes, and that particular care should be given when prescribing antibiotics for young children.

4.1.8 Disability, long-term conditions, and living in care

Social care environments, such as care homes, are considered important places to make gains in relation to AMR [2]. AMR developed in care homes may potentially affect not only residents but also the wider community given the mobile nature of staff and visitors. Studies typically demonstrate high prescribing rates in care homes [68]. In a Scottish study [45], variation in prescribing was influenced by resident case-mix, but there was significant unexplained variation between care homes and between general practices[l]. Overall, more differences were explained by which care home people lived in, than which GP practice they were registered with. Similar findings were observed in a study [68] using the administrative data of a large chain of UK care homes[m].

An OECD study [35] identified several challenges relating to care homes which can lead to higher risk of AMR:

- the vulnerability of residents to infections;

[j] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024

[k] The main survey was undertaken in January 2017 (n=1691); data from an additional sample of parents were collected in April 2017 (n=592). Analyses were weighted to obtain estimates representative of the population.

[l] 148 care-homes in two Scottish regions, with 6633 residents registered with 139 general practices. Prescriptions for any antibiotic and for broad-spectrum antibiotics between 1 April 2016 and 31 March 2017 were analysed using cross-classified multilevel negative binomial regression.

[m] Retrospective cohort study of administrative data from a large chain of UK care homes (resident and care home-level) linked to individual-level pharmacy data. Residents aged 65 years or older between 1 January 2016 and 31 December 2017 were included. 13,487 residents living in 135 homes were included.

- the difficulty of implementing infection control compared to hospital settings;
- limited access to rapid diagnostic testing;
- limited surveillance capabilities;
- the potential for preventative prescribing, which might be appropriate but can still increase the risk of AMR.

However, another review suggested that excessive surveillance and testing could potentially lead to unnecessary treatment of asymptomatic bacteriuria, demonstrating how challenging it is to strike the right balance [69].

According to a 2015 meta-synthesis of qualitative research in the UK [45] healthcare professionals and administrators identified the following factors which influence prescribing decisions:

- variation in knowledge and practice.
- the unique care-home context - complex patients, limited access to doctors and diagnostic tests.
- social factors - interactions between nurses, residents' families and doctors.

A small, relatively old cohort study (data from 2011-13) [70] using electronic health records[n] showed that half of antibiotics prescribed to adults in primary care were for less than ten percent of patients and the presence of any comorbidity increased the prescribing rate by 44%. Recently work has been undertaken to develop resources to support medication reviews for patients with recurring infections to address this concern [2]. The literature reviewed did not find any information about the impact of these changes.

4.1.9 Education, language, and health literacy

As outlined above, patient's experiences can be influenced by prescribers' perceptions of what the patient wants. This might include prescribing antibiotics outside of the guidelines. A nationally representative survey[o] for UKHSA [58] found that people who were educated to graduate level were more likely to have taken antibiotics in the past 12 months than the public overall. They were also more likely to believe they could personally do something to prevent antibiotics becoming less effective. Graduates were also slightly more concerned about AMR for them personally compared with non-graduates. A similar study[p] in 2017 found higher socio-economic status and higher educational qualifications were strongly positively associated with antibiotic knowledge [59].

A qualitative study with CCGs and GPs in England found that a language barrier or low health literacy could lead some patients to demand a prescription, and noted that with limited time for appointments it could be hard to explain why a prescription would not be necessary, leading to potentially higher rates of prescribing [57].

[n] This was a cohort study using electronic health records from 1 948 390 adults registered with 385 primary care practices in the UK in 2011-13.
[o] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024
[p] The main survey was undertaken in January 2017 (n=1691); data from an additional sample of parents were collected in April 2017 (n=592). Analyses were weighted to obtain estimates representative of the population.

5 Conclusion

In conclusion, there is limited evidence about health inequalities in AMR but there are indications that some groups of people, such as migrants, ethnic minorities and people living in deprived areas, are more likely to be at risk of AMR infections but are not necessarily being treated differently.

This is not the first review to recognise these concerns, and the latest UK AMR action plan identifies the need to undertake more research on this topic. Researchers should find ways to move beyond the high level (often aggregate) data, which is most easily available. More in-depth studies are needed that follow-up patients from different communities to better understand experience and outcomes, and consequent impact on health equity.

Specifically, it will be helpful to understand in more depth whether local variation in approach is evidence-based, and responds to the needs of local people, or is ad hoc and associated with other factors such as how busy a GP is or what they perceive the patient wants to happen.

Appendix 1: Methodology and search

The literature searches for this report utilised PubMed, Embase and Google Scholar. The search terms outlined below were used to find initial relevant papers. Then a citation chaining technique was used which involved looking at their reference lists, Cited by, and Similar Articles in PubMed and Google Scholar. Each article found then went through that process.

This was supplemented with general Google searching looking for relevant reports (e.g. government, NHS or charity reports) and also looked any papers cited in those. The articles were collated then deduplicated.

The following terms were combined with “antimicrobial resistance”.

("addict*" OR "adolescen*" OR "Aged" OR "Aging" OR "Asian" OR "asylum seek*" OR "At-risk group*" OR "belief*" OR "bisexual*" OR "Black*" OR "Ethnicity" OR "carer*" OR "child*" OR "Chronic illness patients" OR "civil partnership*" OR "communit*" OR "criminal justice" OR "depriv*" OR "disabilit*" OR "disable*" OR "Disadvantaged communities" OR "discriminat*" OR "domestic violence" OR "Economically disadvantaged" OR "Elderly" OR "Ethnic minorit*" OR "exclude*" OR "exclusion*" OR "families" OR "family" OR "gay" OR "Gender" OR "Gyps*" OR "Health disparities" OR "HIV" OR "AIDS" OR "homeless*" OR "homosexual" OR "immigra*" OR "Incarcerated" OR "inequalit*" OR "Inequity" OR "Intimate partner" OR "Lesbian" OR "LGBT*" OR "Linguistic" OR "Language" OR "english" OR "literacy" OR "Low-income" OR "marginali*" OR "marriage*" OR "maternity" OR "mental health" OR "Migrant workers" OR "minorit*" OR "Non-binary" OR "older" OR "paediatric*" OR "pediatric*" OR "poor" OR "popula*" OR "poverty" OR "pregnan*" OR "protected charact*" OR "queer" OR "race" OR "racial" OR "refugee*" OR "Religi*" OR "Roma" OR "rural" OR "Sexual Identit" OR "sexual orientation" OR "Sexual violence" OR "Social determinants of health" OR "Socially excluded" OR "substance abuse" OR "Substance use" OR "teenager*" OR "Trafficking victim*" OR "transgender*" OR "transsex*" OR "traveling" OR "Traveller*" OR "travelling" OR "undercounted" OR "underrepresent*" OR "underserved" OR "Undocumented" OR "Unemployed" OR "Victims of Violence" OR "vulnerable" OR "Women" OR "Working poor" OR "Young adults" OR "young people" OR "young person*" OR "youth*" OR "detention" OR "detained" OR "criminal record*" OR "parole*" OR "probation*" OR "ex-offender*" OR "offender*" OR "prison*" OR "inmate*" OR "custody" OR "faith*" OR "Christian*" OR "jew" OR "jewish" OR "jews" OR "judaism" OR "islam" OR "muslim*" OR "hindu*" OR "buddh*" OR "deaf" OR "hearing" OR "speech disorder*" OR "speech and language" OR "illiter*" OR "communication problem*")

Appendix 2: Findings by health inequality group

This section takes the evidence from Chapters 3 and 4 and reorganises it by characteristics. Where there was limited or overlapping evidence, some categories have been joined.

5.1 Age

The literature reviewed consistently suggest that infections associated with AMR form a U-shaped curve, with the highest prevalence in the youngest and oldest patients. This pattern can also be seen in AMR specifically, but the patten varies depending on both specific bacteria and specific antibiotic [44]. An important exception to the U-shape is *E. coli*, for which research looking at age and sex found elevated infection incidence in females between the ages of 15 and 40 [44]. To give another example, in the winter of 2022 to 2023 in the UK, children were at particularly high risk of infection with Group A *Streptococcus*. Generally, older adults are more susceptible to AMR related illness, potentially due to incidence of infections and comorbidities [2].

A global study [31] found AMR mortality rates are changing. For children under five there was a 50% reduction in mortality between 1990 and 2021, whereas for adults the mortality rate has increased. These improvements for children are largely attributed to vaccination programmes and improved access to WASH. In contrast, AMR mortality increased by over 80% among adults over 70 years in the same period.

Focussing on UK data, the UKHSA [25] found that the number and rate of both bacteraemia and resistant bacteraemia were highest in the over 74 years age group, followed by the 65 to 74 age group and the youngest age group, under one years. It concluded "Between 2019 and 2023, rates of reported bacteraemia in children aged 0 to 17 years increased from 118.5 to 148.6 per 100,000 population[q]." Figure 12 shows that bacteraemia rates were highest in children aged under one. In this age group in 2023, half of the bacteraemia episodes occurred in infants that were older than one month, and half in infants younger than one month (with 19.6% occurring in under three day olds, and 30.4% in four day to one month olds)."

Figure 12: AMR burden from bacteraemia by age group in England in 2023 [25]

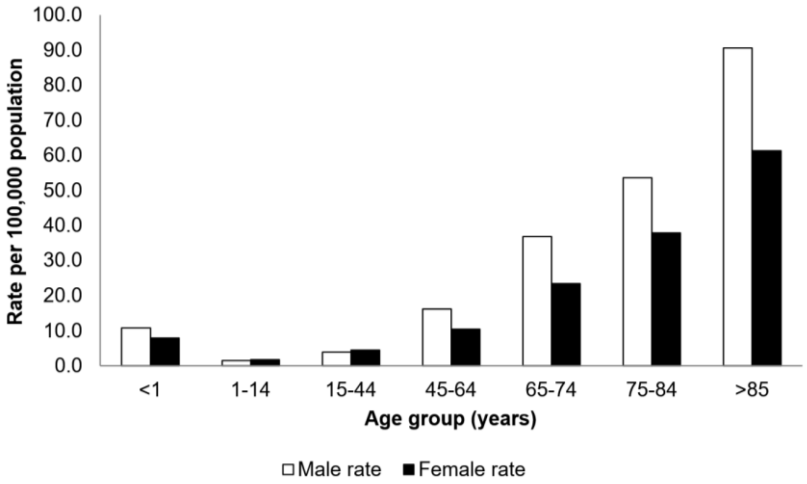
Age group (years)	Rate of bacteraemia per 100,000 population (n)	Rate of resistant bacteraemia per 100,000 population (n)	Percent resistant (95% confidence intervals)
Under 1	285.1 (1,652)	49.2 (285)	17.3% (15.4 to 19.1)
1 to 4	35.1 (870)	5.1 (128)	14.7% (12.3 to 17.0)
5 to 9	12.3 (411)	1.7 (56)	13.6% (10.3 to 16.9)
10 to 14	13.5 (462)	1.8 (62)	13.4% (10.3 to 16.5)
15 to 44	37.5 (8,122)	7.5 (1,619)	19.9% (19.1 to 20.8)
45 to 64	127.0 (18,506)	26.4 (3,845)	20.8% (20.2 to 21.4)
65 to 74	311.8 (17,359)	68.6 (3,819)	22.0% (21.4 to 22.6)
Over 74	830.0 (40,684)	183.8 (9,008)	22.1% (21.7 to 22.5)
Unknown	0.0 (19)	0.0 (6)	29.4% (9.0 to 49.9)

Equally, NHS data shows CPO incidence is highest for the oldest and youngest members of the population [15] (see Figure 13). The highest annual rate reported was for people aged 85 years and

[q] (n=13,973 to 17,663)

over (72.4 per 100,000 population) followed by those aged 75 to 84 years (45.1 per 100,000 population). For infants less than one year old, the CPO annual incidence rate was 9.4 per 100,000 population.

Figure 13: Annual rate of acquired CPO episodes per 100,000 population by age and sex (data from 2024) [15]



As outlined above, in 2023, the overall case fatality rate for 30-day all-cause mortality in UK patients with selected Gram-negative bacteraemia (*E. coli, K. pneumoniae, Pseudomonas spp., Acinetobacter spp.*) was 15.5%. This varied by age: fatality was lowest in children aged 1 to 14 years (4.4%) and highest in adults aged 85 years and over (21.8%) [25].

In 2023, the highest rate of antibiotic use in primary care continued to be in adults aged over 65 [25]. Other studies have also shown that older adults, especially those in residential care, have the highest antibiotic use [55]. An American review [65] found that "in the outpatient setting, (antimicrobial prescribing) tends to be high in infants, decreases in older children and young adults, and increases again for the elderly." This reflects the U-shaped curve for cases of infection, outlined in section 3.1.6.

A study based on 2015 NHS data showed that for most common infections treated in primary care a substantial proportion of antibiotic prescriptions had durations exceeding those recommended in guidelines. No large differences in antibiotic prescriptions between children and adults were found [8].

As outlined, patient experience can be influenced by prescribers' perceptions of what the patient wants [51] [52]. A nationally representative survey[r] for UKHSA [58] found that younger people (aged 16 to 24 years old) were more likely to have taken antibiotics in the past 12 months. They were equally likely to believe they could personally do something to prevent antibiotics becoming less effective, and less likely to be concerned about AMR for them personally than people aged over 65. A 2017 survey in England [59], showed the youngest (15–24 years) and oldest (65 +years) were less knowledgeable about antibiotics[s].

[r] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024

[s] The main survey was undertaken in January 2017 (n=1691); data from an additional sample of parents were collected in April 2017 (n=592). Analyses were weighted to obtain estimates representative of the population.

While there appear to be few differences in access or experience of AMR by age in the literature identified, there is some evidence that exposing a child to antibiotics may affect normal immune development, and may lead to greater susceptibility to infections [67]. This may mean that equal treatment might not lead to equal outcomes, and that particular care should be given when prescribing antibiotics for young children.

5.2 Religion and belief

There were very limited findings relating to religion or beliefs. The only evidence was some limited references to vaccine hesitancy which, as discussed, can lead to higher need for antimicrobial treatments in unvaccinated patients.

A working paper for the SAGE Committee of the WHO [63] attributed lower vaccination rates to a number of factors including:

- contextual influences e.g. religion/culture/gender/socio-economic, communication and media environment.
- individual and group influences e.g. personal experience with vaccination, health system and providers trust.
- vaccine/vaccination specific issues e.g. risk/benefit, epidemiologic and scientific evidence, mode of delivery and cost.

5.3 Sex, gender, sexual orientation, and pregnancy

NHS CPO reporting data shows the annual rate was higher in males compared to females (overall rates of 14.5 and 11.5 episodes per 100,000 population) [15]. However, the literature reviewed did not include any other data relating to sex or gender and prevalence of AMR except one study that found variation by age-group [44].

There are a few more narrowly focussed findings. For example, a review found pregnancy and childbirth heighten the risk of infections, and can result in the use of antibiotics for both therapeutic and prophylactic purposes [6]. The same report stated women are usually at a higher risk of contracting UTIs, but there is no evidence that these differences lead to higher AMR. In fact, a study by the London School of Hygiene & Tropical Medicine [44] found that, in general, males had a higher risk of AMR than females[t]. Similarly, one systematic overview of reviews [42] found several suggesting higher prevalence of infectious diseases and AMR among men who have sex with men. However, the studies referenced focus on a couple of specific resistant diseases rather than AMR as a whole.

The only literature identified about access and experience of healthcare relates to antibiotic use rather than experiences of AMR specifically. According to several reviews looking at high income countries [56] [66], most studies report higher antimicrobial prescribing for women patients compared with men. This may be largely driven by the use of antibiotics to treat UTIs [55]. However, they also found that there is some evidence that women admitted for severe or septic shock wait longer for antimicrobials than men do. [28].

As outlined in section 4.1, patient experience can be influenced by prescribers' perceptions of what the patient wants. This might include prescribing antibiotics outside of the guidelines. A

[t] A total of 6,862,577 susceptibility results from isolates with age, sex, and spatial information from 944,520 individuals were used to characterise resistance prevalence patterns for 38 different bacterial species and antibiotic combinations. A total of 349,448 isolates from 2019 with age and sex metadata were used to calculate incidence.

nationally representative survey[u] for UKHSA [58] found that men and women were: equally likely to have taken antibiotics in the past 12 months; equally likely to believe they could personally do something to prevent antibiotics becoming less effective; and equally likely to be concerned about AMR for them personally.

The guidelines for antimicrobial prescribing have been adjusted over time, typically to reduce the length of the course of treatment. According to a study [8] based on 2015 NHS data for most common infections treated in primary care, a substantial proportion of antibiotic prescriptions had durations exceeding those recommended in guidelines. In particular, for respiratory conditions and acute cystitis among females. This study also found that men were receiving antibiotics for shorter than recommended durations for UTIs which the authors believed could indicate a risk of harm from under-treatment.

An American study found that younger pregnant women used more antibiotics than older pregnant women [66]. No UK data about access and experience of antibiotic use or AMR was identified in the literature reviewed.

5.4 Asylum seekers, refugees and migrants

The academic literature relating to AMR prevalence among different groups is very limited. In the literature reviewed, the most consistently identified group related to AMR in migrant communities. This has been attributed to a range of factors including:

- the higher risk of transmission during migration, or in host countries, due to social factors like overcrowding in refugee camps or other accommodation.
- disrupted access to healthcare, and poor access to water, sanitation and hygiene [1].

One study from the Netherlands found that the impact of picking up a resistant strain can be long-lasting: AMR carriage in asylum seekers showed no particular decline more than a year after arrival [37].

A 2023 systematic review and meta-analysis of AMR in migrants in Europe [38] found that the pooled prevalence for any detected AMR was 28.0%, compared to 25.4% in 2017. Wide confidence intervals might mean that this change may not be significant[v]. The authors assert this is a 'high' rate but do not attempt to produce a comparison with the general population in the host countries, country of origin or transit. Their analysis found AMR was more common in community settings, such as refugee camps, transit hubs and detention centres, rather than in hospitals for people living in large migrant populations. The authors found "it remains unclear whether migrants bring resistant organisms from their country of origin, or whether they acquired the organism in transit, or in refugee centres." This review also found no evidence of a link between AMR acquisition and arrival time or length of stay.

Qualitative research with migrants in the UK found several reasons why migrants may be more at risk acquiring and transmitting diseases including AMR. These included:

- living conditions during the journey to the UK, especially for those not entering the UK with a visa.

[u] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024
[v] For the estimate of 28.0% the 95% confidence interval was between 18.0%–41.0%

- living conditions in temporary accommodation in the UK, including shared accommodation and hotels.
- difficulties accessing clean water and sanitation, both on the journey and in the UK [39].

Similarly, institutional settings such as migration centres can be at risk of spread and outbreaks of infectious diseases, including infections from geographic regions with high prevalence of resistance [2].

Qualitative research [39] has found that there are a number of barriers for migrants seeking to access healthcare when they need it. This could be a problem throughout their journey to the UK, but also when in the UK. Barriers within the UK include: not knowing how to navigate the NHS; experiencing long waits; finding it difficult to find, or trust, an interpreter. The migrants also discussed financial barriers to both buying essentials to maintain hygiene and to pay for prescription drugs if they were needed. Some of the participants in the study obtained antibiotics without a prescription to bring with them to the UK, they were concerned about their ability to access healthcare. This could lead to inappropriate use of antibiotics.

A review [54] found other studies have also shown that the NHS Charges to Overseas Visitors Regulations might lead to fears of charging and data sharing; factors which are known to deter some migrants from accessing healthcare. The study also noted that evidence was lacking. In the UK, data sources commonly used for tracking and researching AMR do not include information about who is a migrant, limiting the analysis that can be done.

5.5 Deprivation, employment, and poverty

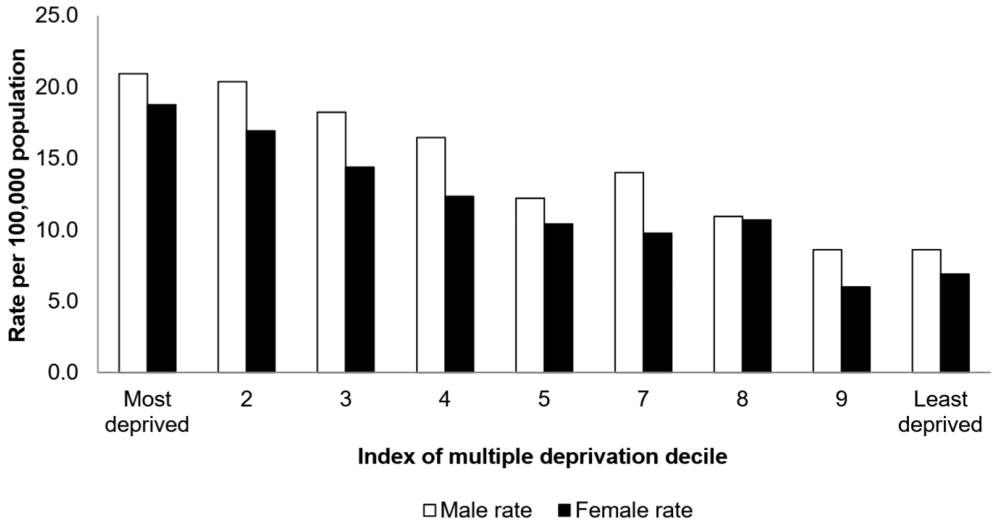
Comparing those living in the most deprived areas to those living in the least deprived areas, emergency admission rates per 10,000 people are twice as high for infectious respiratory diseases, twice as high for invasive infections, and 1.7 times higher for infectious gastrointestinal diseases [41]. In this context, the UKHSA's ESPAUR report [25] notes that AMR burden varies by Indices of Multiple Deprivation (IMD). Nationally, the highest AMR rates were seen in the most deprived populations of England. The report also notes that the difference between the most and least deprived widened between 2019 and 2023. Case fatality rates from Gram-negative organisms in the most and least deprived IMD quintiles were the same (15.6%). However, the estimated number of deaths was 30.8% higher in the most deprived quintile (est.=1,701) than in the least deprived quintile (est.=1,300), driven by higher numbers of infections.

Figure 14: AMR bacteraemia burden by IMD quintile in England [25]

IMD quintile	Rate of bacteraemia per 100,000 population (n)	Rate of resistant bacteraemia per 100,000 population (n)	Percent resistant (95% confidence intervals)
1 (most deprived)	173.5 (19,601)	38.1 (4,301)	21.9% (21.4 to 22.5)
2	157.3 (18,299)	34.1 (3,963)	21.7% (21.1 to 22.3)
3	149.8 (17,201)	31.0 (3,559)	20.7% (20.1 to 21.3)
4	145.1 (16,219)	30.2 (3,376)	20.8% (20.2 to 21.4)
5 (least deprived)	130.9 (14,338)	26.7 (2,925)	20.4% (19.7 to 21.1)

The NHS CPO data (see Figure 15) demonstrates a clear relationship between CPO episodes and IMD (measured using a set of factors that includes their levels of income, employment, education and local levels of crime). CPO episodes are more likely to be reported in the most deprived parts of the country.

Figure 15: Annual rate of acquired CPO episodes per 100,000 population by index of multiple deprivation decile and sex (2024) [15]



A systematic overview of reviews for Public Health England [42] found "the evidence consistently shows that those with lower level of income, lower educational attainment, unemployment, higher area level deprivation, lower socioeconomic status or poor living situations are at higher risk of infectious diseases, AMR, and lower vaccine uptake."

An American study [43] concluded that "Poverty probably plays a role in antimicrobial resistance within the United States as well, but little research has occurred in this area."

As noted in section 3.1.4, there are higher rates of infectious diseases and AMR in areas with high deprivation. There is a positive association between increasing level of deprivation and increasing rates of antibiotic use in primary care [25]. The UKHSA ESPAUR report states that, in 2023, the rate of total antibiotic use for the most deprived quintile was 69.1% higher than the rate of use in the least deprived quintile, and the gap had increased since 2019. The report also shows that broad spectrum antibiotic use was higher in the most deprived areas, although the difference in the proportion of broad spectrum use between the most and least deprived areas is falling. Other studies have looked at whether differences in prescribing can be explained by comorbidities or smoking[w] [63], or after adjusting, using a proxy indicator of health need [56] (proportion of patients with COPD and diabetes) [x]. They conclude that these factors could explain some, but not all, variance .

It is hypothesised that higher prescription rates in areas with higher deprivation reflect both differences in healthcare quality and access, and also underlying differences in the population health need [56]. For example, more deprived areas have lower GP provision per head and are more reliant on locum doctors.

Qualitative research with people from CCGs and GPs [57] suggested the following could lead to higher antibiotic prescribing in areas which are most deprived:

- more illness and comorbidities overall.

[w] Study used publicly available data from 7376 general practices in England between April 2014 and March 2015 were used.
[x] Overall, 29,631 GP surgeries were included in the analysis for antibiotic prescribing over the 4 years for which data were available for the 4 years from April 2014–March 2015 to April 2017–March 2018 (representing 7700 unique surgeries).

- less perceived ability to self-care.
- less access to over-the-counter remedies.
- a lower threshold for seeking GP appointments earlier in the illness and expecting antibiotics.
- a greater need for illness validation e.g. sick notes, and for a quicker recovery in order to get back to work.

5.6 Disability, long term conditions, and living in care

The National Action Plan [2] states that "Several different groups are more vulnerable to infection and resistance, including people with disabilities and people in high risk settings" but does not provide a reference for this statistic. Several studies have found that care home residents have higher rates of antibiotic-resistant infections than older people living in their own homes [45].

Social care environments, such as care homes, are considered important places to make gains in relation to AMR [2]. AMR developed in care homes may potentially affect not only residents but also the wider community, given the mobile nature of staff and visitors. Studies typically demonstrate high prescribing rates in care homes [68]. In a Scottish study [45], variation in prescribing was influenced by resident case-mix, but there was also significant unexplained variation between care homes and between general practices[y]. Overall, it found more differences were explained by which care home people lived in than which GP practice they were registered with. Similar findings were observed in a study [68] using the administrative data of a large chain of UK care homes[z].

An OECD health policy study [35] identified several challenges relating to care homes which can lead to higher risk of AMR:

- the vulnerability of residents to infections.
- the difficulty of implementing infection control compared to hospital settings.
- limited access to rapid diagnostic testing.
- limited surveillance capabilities.
- the potential for preventative prescribing, which might be appropriate but can still increase the risk of AMR.

However, another review suggested that excessive surveillance and testing could potentially lead to unnecessary treatment of asymptomatic bacteriuria, demonstrating how challenging it is to strike the right balance [69].

According to a 2015 meta-synthesis of qualitative research in the UK [45] healthcare professionals and administrators identified the following factors which influence prescribing decisions:

- variation in knowledge and practice.
- the unique care-home context - complex patients, limited access to doctors and diagnostic tests.

[y] 148 care-homes in two Scottish regions, with 6633 residents registered with 139 general practices. Prescriptions for any antibiotic and for broad-spectrum antibiotics between 1 April 2016 and 31 March 2017 were analysed using cross-classified multilevel negative binomial regression.

[z] Retrospective cohort study of administrative data from a large chain of UK care homes (resident and care home-level) linked to individual-level pharmacy data. Residents aged 65 years or older between 1 January 2016 and 31 December 2017 were included. 13,487 residents living in 135 homes were included.

- social factors - interactions between nurses, residents' families and doctors.

A small cohort study using relatively old electronic health record data (2011-13) [aa] showed that half of antibiotics prescribed to adults in primary care were for less than ten percent of patients [70]. The presence of any comorbidity increased the prescribing rate by 44%. Recently, resources to support medication reviews for patients with recurring infections have been developed to address this concern [2]. The literature reviewed did not include any information about the impact of these changes.

5.7 Literacy, education, and English not first language

No evidence relating to prevalence or outcomes was identified in the literature reviewed, although the information about migrant communities might be relevant.

As outlined, patient experience can be influenced by prescribers' perceptions of what the patient wants. This might include prescribing antibiotics outside of the guidelines. A nationally representative survey[bb] for UKHSA [58] found that people who were educated to graduate level were more likely to have taken antibiotics in the past 12 months than the public overall. They were also more likely to believe they could personally do something to prevent antibiotics becoming less effective. Graduates were slightly more concerned about AMR for them personally compared with non-graduates. A similar study[cc] in 2017 found higher socio-economic status and higher educational qualifications were strongly positively associated with antibiotic knowledge [59].

A qualitative study with CCGs and GPs in England found that a language barrier or low health literacy could lead some patients to demand a prescription. With limited time for appointments it could be hard to explain why a prescription would not be necessary, leading to potentially higher rates of prescribing [57].

5.8 Mental illness, and substance use

People who inject drugs are also likely to be at disproportionately high risk of invasive bacterial infections, including bacteraemia due to MRSA, *Methicillin-Susceptible Staphylococcus Aureus* (MSSA) and Invasive Group A *Streptococcal* infections [41]. This could be due to unsterile injecting and barriers to accessing care [46]. However, there is a lot of missing data in NHS datasets which mean it is difficult to assess this accurately [46]. The literature identified did not find information relating to AMR, or access and experience of healthcare for AMR specifically.

5.9 Geography: urban v rural

The literature reviewed included regional analysis which is included below. The only specific data about urban v rural differences was a study based on NHS GP prescribing data from 2014-2018. This demonstrated that GPs in rural areas showed higher rates of antibiotic prescribing than those in urban locations [56]. An American study hypothesised this could be due to decreased access to care or difficulties getting to the health service, and limited access to diagnostic equipment [64] although the distances are likely to be far longer in the USA.

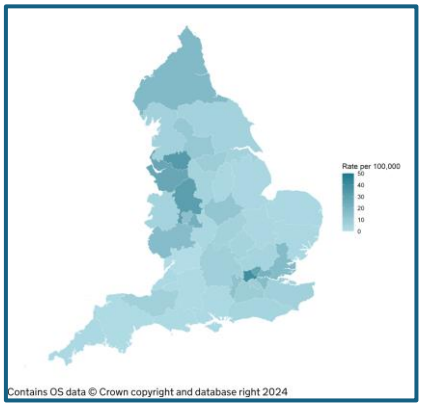
[aa] This was a cohort study using electronic health records from 1 948 390 adults registered with 385 primary care practices in the UK in 2011-13.

[bb] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024

[cc] The main survey was undertaken in January 2017 (n=1691); data from an additional sample of parents were collected in April 2017 (n=592). Analyses were weighted to obtain estimates representative of the population.

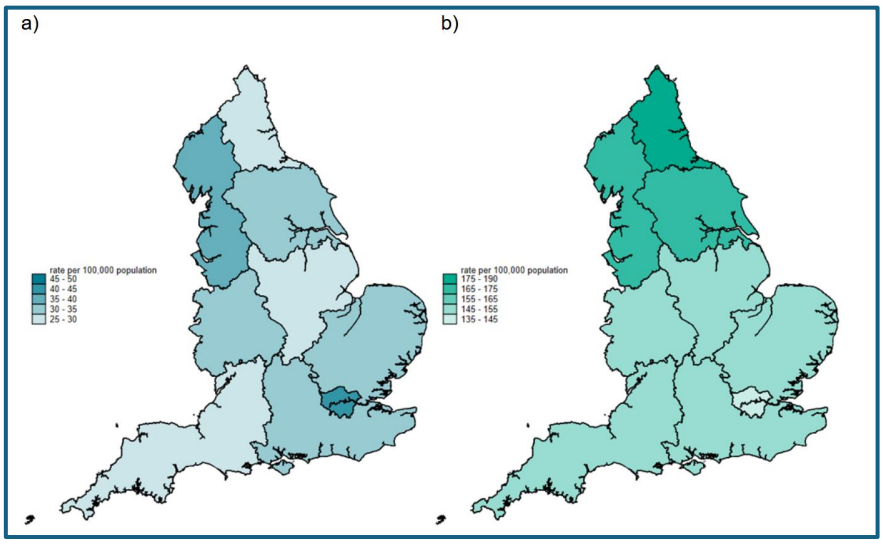
The NHS CPO screening data (see Figure 16) demonstrates that prevalence acquired CPO incidence rates vary by region, with particularly high rates in London and the North West (especially North West London and Greater Manchester) [15]. This might in part reflect different outbreaks, or approaches and policies relating to screening and reporting.

Figure 16: Integrated Care Board (ICB) regional distribution of acquired CPO annual incidence rates per 100,000 population (England): January 2024 to December 2024 [15]



A similar pattern is identified in the UKHSA English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR) report [25] (Figure 17), although while the highest AMR burden is located in London and the North West, the estimated numbers of all bacteraemia (the presence of bacteria in the blood whether or not resistant to antimicrobials) are highest in the North East, based on data from screening samples.

Figure 17: Regional variation in the rate per 100,000 of a) estimated burden of AMR and b) estimated numbers of bacteraemia in England in 2023 [25]



Data about antibiotic consumption [25] demonstrates that although London experiences the greatest AMR burden, prescription of antibiotics in both primary and secondary care are lower. UKHSA suggest this could be due to differences in access. Prescriptions of antibiotics (measured in Daily Defined Doses per 1,000 inhabitants per day) are highest in the North East and North West. The literature reviewed did not explain whether high levels of antibiotic prescription and higher levels of AMR were causal (in either direction), correlated or coincidental. There is some

evidence from the USA that reducing broadly distributed, low-intensity antibiotic use could be more effective than reducing high-intensity use to minimise AMR [53].

5.10 Pregnancy, and marriage

The literature reviewed included limited evidence relating to pregnancy and marriage. An American study found that younger pregnant women used more antibiotics than older pregnant women [66]. No UK data about access and experience of antibiotic use, or AMR was identified in the literature reviewed.

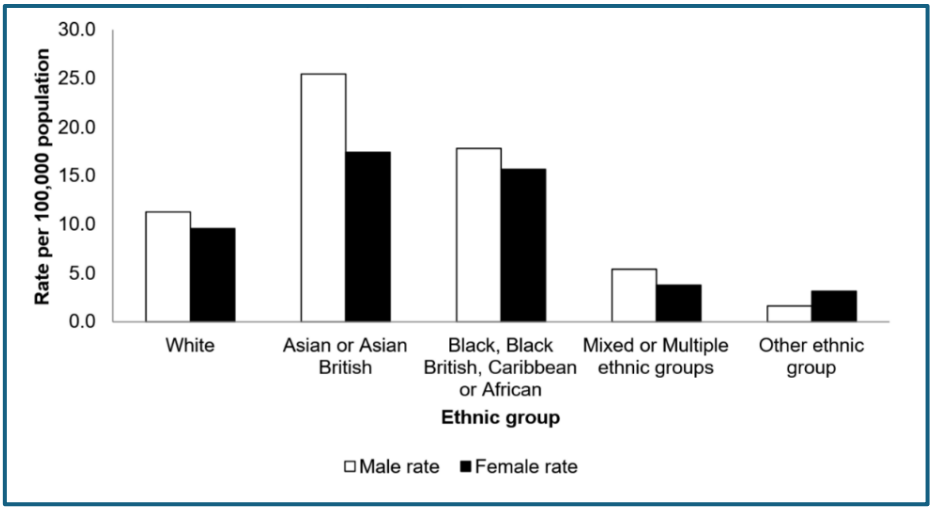
5.11 Homeless

A systematic overview of reviews [42] found several studies that demonstrated a higher risk of various infectious diseases or AMR among people experiencing homelessness, compared with those who were not homeless. Similarly, a report on infections among people who inject drugs, suggests that homelessness may contribute to risk of infection [46]. The literature reviewed did not identify any further information about access and experiences of care relating to AMR.

5.12 Race and ethnicity

As shown in Figure 18, the NHS CPO data demonstrates that incidence rates vary by ethnic group, with the highest annual rate reported in those of Asian or Asian British ethnicity, followed by people of Black or Black British, Caribbean or African ethnicity [15]. The data also shows that different ethnic groups have a different distribution of the CPO families – NDM is most common in individuals of Asian ethnicity (55.3% of episodes reported), while KPC is rare in people of Asian ethnicity (5.1% of episodes), but appears more frequently in people of White ethnicity (25.9% of episodes). OXA-48-like episodes account for approximately one third of cases in each ethnic group.

Figure 18: Annual rate of acquired CPO episodes per 100,000 population by ethnic group based on notifications to UKHSA by all diagnostic laboratories in England [15]



According to UKHSA [25], as shown in Figure 19, the pattern is similar for AMR bacteraemia burden by ethnic group: Asian or Asian British people have the highest AMR burden, while White and Mixed race ethnicities are lower (the difference between them is not statistically significant). The resistance categories considered include eight bacteria including those listed above and MRSA, and four or more different classes of antibiotics [40].

Figure 19: AMR bacteraemia burden by ethnic group in England (2023) [25]

Ethnic group	Rate of bacteraemia per 100,000 population (n)	Rate of resistant bacteraemia per 100,000 population (n)	Percent resistant (95% confidence intervals)
White	146.7 (71,457)	29.5 (14,365)	20.1% (19.8 to 20.4)
Asian or Asian British	84.5 (4,659)	33.3 (1,835)	39.4% (38.0 to 40.8)
Black, African, Caribbean or black British	104.0 (2,505)	27.5 (663)	26.5% (24.8 to 28.2)
Mixed or multiple ethnic groups	37.9 (651)	8.4 (145)	22.3% (19.1 to 25.5)
Any other ethnic group	23.9 (300)	4.4 (55)	18.2% (13.9 to 22.6)
Not known or Not stated	N/A (1,304)	N/A (208)	16.0% (14.0 to 17.9)

* 6,130 (7.6%) bacteraemia episodes could not be linked to obtain ethnic group information. The percentage resistant in this group was 19.8% (n=1,212).

However, despite the higher AMR burden in ethnic minority groups, of those patients for whom ethnicity was reported, the same report [25] found that the crude unadjusted case fatality rate for patients infected by Gram-negative organisms was highest in the White ethnic group (16.2%) and lowest in, or multiple ethnic groups (9.5%). Separate analysis showed patients infected with an *E. coli* or *K. pneumoniae* strain resistant to one or more AMR burden-defined antibiotics had a statistically significant higher crude case fatality rate compared to those with a susceptible strain (16.1% vs 14.0% respectively).

The literature identified highlighted the importance of country context when exploring ethnicity and antibiotic use [55]. Consequently, this review focusses on data about ethnic minority groups living in the UK, where antibiotics are only available through prescription at a relatively low financial cost to the patient.

In a study from 2020, prescribing data from GPs in the NHS[dd] suggested that there were higher levels of antibiotic prescribing in areas with a greater proportion of people of White ethnic origin [56]. However, a qualitative study with CCGs and GPs in England [57] considered deprivation and ethnic minority populations together. Interviews with people from ethnic minority groups (and in areas with higher levels of deprivation) suggested that they were perceived as needing more antibiotics. This was after considering the wider context of their lives including their perceived ability for self-care, reconsult, their risk of complications, and the impact on them of not working.

As outlined in section 4.1, patient experience can be influenced by prescribers' perceptions of what the patient wants [51] [52]. This might include prescribing antibiotics outside of the guidelines. A nationally representative survey[ee] for UKHSA [58] found that people from ethnic minority groups were more likely to have taken antibiotics in the past 12 months, were less likely to believe they could personally do anything to prevent antibiotics becoming less effective, and were slightly more concerned about AMR for them personally compared to White people. This finding is

[dd] Antibiotic prescribing data were obtained from the NHS Business Services Authority ePACT2 system. The data were downloaded for English General Practices (GPs) for the 4 years from April 2014–March 2015 to April 2017–March 2018. All GP practices open for the entire year were included in the analysis

[ee] Unweighted base 4091, weighted to be nationally representative, fieldwork March 2024

consistent with a previous 2017 English survey [59] where Black, Asian and minority ethnic adults were also found to be less knowledgeable about antibiotics[ff].

Vaccine uptake

Vaccine hesitancy among ethnic minority groups might also lead to higher prevalence of AMR in these groups. A European systematic review [60] found that under-vaccinated groups include Orthodox Protestant communities, Anthroposophists, Roma, Irish Travellers, and Orthodox Jewish communities. This study found "the most frequently mentioned shared reasons for not vaccinating their children were:

- the perceived non-severity of the disease.
- the perceived un-safety of the vaccine e.g. the fear of side effects and misconceptions.
- the need for more information, or the lack of information about, for example ,risks of vaccination".

An NHS report [61] produced to support COVID vaccine uptake found significantly lower vaccination rates in ethnic minority groups, especially Black people, but also Bangladeshi and Pakistani people.

A working paper for the SAGE Committee of the World Health Organisation [62] attributed lower vaccination rates to a number of factors including:

- contextual influences e.g. religion/culture/gender/socio-economic, communication and media environment.
- individual and group influences e.g. personal experience with vaccination, health system and providers trust.
- vaccine/vaccination specific issues e.g. risk/benefit, epidemiologic and scientific evidence, mode of delivery, costs.

As noted above, the presence of NDM-producing organisms differs by ethnic group, and they are more common in people from Asian and Black ethnic groups. According to UKHSA [25], these organisms are some of the most resistant and challenging organisms to treat, with extremely limited treatment options. The literature reviewed did not find any papers which looked at how many patients received the most appropriate treatment option first time, i.e. not trying to treat a patient with an antibiotic to which they or their infection were resistant.

5.13 Criminal justice system

The literature reviewed did not identify any evidence relating to AMR and the criminal justice system.

[ff] The main survey was undertaken in January 2017 (n=1691); data from an additional sample of parents were collected in April 2017 (n=592). Analyses were weighted to obtain estimates representative of the population.

Appendix 3: Acronyms

AMR: Antimicrobial resistance (see definition in 2.1)

IMD: Index of Multiple Deprivation (IMD) is a measure of the relative level of disadvantage across small areas in England and is often split into quintiles. IMD 1 represents the 20% most deprived neighbourhoods in England through to IMD 5, which represents the 20% least deprived neighbourhoods in England.

ESPAUR: English surveillance programme for antimicrobial utilisation and resistance

NHS: National Health Service

UKHSA: UK Health Security Agency

UTI: Urinary tract infection

WASH: **WA**ter, **S**anitation and **H**ygiene

WHO: World Health Organisation

As mentioned above (section 2.1), there are five main carbapenemase families and the NHS reporting uses these acronyms and not the full names. The names and acronyms are:

- KPC (*Klebsiella pneumoniae carbapenem*),
- OXA-48-like (*Oxacillinase-48-like beta-lactamase*),
- NDM (*New Delhi metallo-beta-lactamase*),
- VIM (*Verone integron-encoded metallo-beta-lactamase*) and
- IMP (*Imipenemase-Type metallo-beta-lactamase)*

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